ENGINEERING NEWS

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GEO. H. FROST, PROPRIETOR.

SATURDAY, FEBRUARY 19, 1881.

NEW YORK STATE has been hitherto an exception in its legislation with regard to the incorporation of companies transacting business in foreign countries. Assemblyman Moller has brought in a bill placing the incorporation fee at fifty dollars. Now that so many of our railroad builders and contractors are casting their eyes Mexico-wards, such a law would be quite timely.

QUITE a discussion has grown up—*per et contra* the Berme Canal Bank Railroad (Erie Canal). General Tremaine has given in a long report on the advantages of such an enterprise; State Engineer Seymour is as zealously against, and considers horse power as the cheapest method of towage in the particular case of the Erie. He also gives some statements with regard to the declivities of the banks, etc., which must be taken into consideration.

THE new Brazilian railway law is not favorably commented on by the Rio Janeiro press. The restrictions are unusually numerous and annoying. Additional surveys, modification of plans, etc., may be made at the expense of the company or contractors. Telegraph lines belonging to the company may be confiscated at will, and the whole of the thirty-eight articles seem to be rather unnecessarily arbitrary. It is surprising to hear, however, that the Minister of Agriculture, who is the author of the law, is himself an engineer.

NON-DIPLOMAED, if not inefficient, engineers are having a hard time in Brazil. The chief of the Dom Pedro II. railway telegraph department has been discharged because he does not hold the required scientific degree. There is no complaint about inefficiency, but the new regulations are strict. This is hard for a man who has been 22 years in a position. Another engineer—the chief of the first section—has been given a conductor's place. It is better, however, for all concerned, that there should be some guarantee as to technical capacity.

AMERICAN INSTITUTE OF MINING ENGINEERS.

The opening meeting of the American Institute of Mining Engineers, was called to order by William P. Shinn, the president, on the evening of the 15th inst., in the hall of the Franklin Institute, Philadelphia, about one hundred and fifty members being present. The address of welcome was then delivered by Hon. Wayne MacVeagh, who stated that the reception committee had purposed that the institute should be welcomed by one of the first citizens of Philadelphia, Mr. John Welsh; but that in his absence he would in a few informal words assure the members of the honor the visit would confer upon the city and of the high appreciation in which the works of the Institute were held. The speaker then paid a glowing tribute to the professions of both mining and mechanical engineers.

Mr. Shinn delivered the customary address from the chair, after having briefly acknowledged the welcome which had been so courteously proffered. He reviewed the development of mining in the United States during the past five years, in the iron and steel industries, in railroad building and in all the enterprises in which the membership is particularly interested. "I have no hesitation," he remarked, "in saying that to this Institute is due a considerable proportion, first, of the increase in quantity, and second of the increase in economy of production, more particularly the latter. We all know that to one of our members is due the possibility of the enormous increase in the production of Bessemer steel in this country, and we all know it is due to the efforts of our members, in their various lines of work and thought, that the great economies of these productions have been brought about. I trust that my successor—five years hence—may be able to give as good an account of progress of the next five years as I have been able to give of the past five."

The first paper of the session was read by Mr. O. A. Moses, an assistant of Mr. Edison, on the subject of Mr. Edison's system of electric lighting applied to mining. Upon each side of the platform rows of lamps were arranged, those upon one side being what are termed half and quarter lamps, adapted to mining on account of their size, and those upon the other what are called whole lamps, or those intended to be used for domestic purposes. They were connected with a Brush dynamo-electric machine, and a practical test given of their utility. The powers of the various sizes, the electro-motive force employed, and the resistance of each, were all minutely described. He said: "The method to be adopted in applying the Edison light to mines is very simple. Wires run direct from the dynamo-electric machine to the different workings, supplying light to the shaft on their way. Each lamp may, if desired, be immersed in water, or be protected from fracture by a coarse wire screen; the connections can all be made under water, and thus lamps may be put in or out of circuit without the slightest danger from the electric spark." Mr. Moses further stated that "one of the most important advantages of this light is in the saving of money required in coal mining for hermetically sealing up old workings, or where these have to be visited or reopened after having been temporarily abandoned and filled with fire-damp."

This closed the meeting, and the members, in a body, attended a reception tendered them by Professor Persifor Frazier at the Penn Club.

The following members were present: Percival Roberts, Jr., Charles S. Hinchman, John S. Alexander, H. Bradford, E. Borda, John Birkinbine, Charles E. Billin, Charles A. Ashburner, Charles A. Brinley, J. Blodget Britton, William Burnham, Martyn H. Chance, Russell W. Davenport, H. J. Drinker, F. A. Genth, Jr., Robert P. Field, James M. Ferguson, Thomas Graham, Franklin B. Gowen, Howard B. Griffiths, J. K. Griffith, E. B. Harden, O. B. Harden, Wm. R. Hart, John M. Hartman, S. S. Hartranft, John L. Wilson, S. W. Ingersoll, W. A. Ingham, John W. Hoffman, Persifor Frazer, Charles S. Hinchman, Jerome Keeley, Professor George A. Koenig, Richard Henry Lee, William Weir McKee, A. M. McComb, E. F. Loiseau, Professor J. P. Lesley, James Moore, William J. Neilson, Israel W. Morris, J. Thorpe Potts, Henry Pettit, A. Pardee, Jr., C. C. Newton, Theodore D. Rand, H. B. Richmond, E. G. Spilsbury, Robert A. Shillingford, William Sellers, C. Henry Roney, Richard H. Sanders, David Townsend, Henry T. Townsend, Professor C. P. Williams and Henry A. Vezin, all of Philadelphia; Frank S. Witherbee, Port Henry, N. Y.; W. W. Van Voorhis, Manhattanville, N. Y.; W. R. Symons, Pottsville, Pa.; Oliver P. Scaife, Pittsburgh; Charles L. Taylor, Pittsburgh; C. R. Boyd, Wytheville, Va.; M. L. Brosius, Lewistown, Pa.; John Bogart, New York; James A. Burden, Troy, N. Y.; Harvey B. Chess, Pittsburgh; G. H. Billings, Boston, Mass.; Henry Burden, Troy, N. Y.; W. E. C. Eustis, Boston; Martin Coryell, Lambertville, N. J.; R. Neilson Clark, Colorado Springs, Col.; Dr. Thomas M. Drown, Easton, Pa.; E. B. Ely, New York; Professor A. Jay DuBois, New Haven, Conn.; Eckley B. Coxe, Lucerne County, Pa.; Dr. Charles B. Dudley, Altoona, Pa.; J. H. Harden, Phœnixville, Pa.; John Griffin, Phœnixville, Pa.; Robert W. Hunt, Troy, N. Y.; George Jamme, Londonderry, Nova Scotia; E. D. Leavitt, Jr., Cambridgeport, Mass.; Charles Kirchoff, Jr., Hoboken, N. J.; W. R. Jones, Pittsburgh; Levi Holbrook, New York; L. G. Laurea, New York; Charles H. Morgan, Worcester, Mass.; James F. Lewis, Quinnimont, W. Va.; Geo. W. Maynard, N. Y.; J. H. Ricketson, Pittsburgh; Joseph C. Platt, Jr., New York; Gen. Paul A. Oliver, Wilkesbarre, Pa.; Edward Nichols, Floyd County, Ga.; John C. F. Randolph, New York; Joseph D. Weeks, Pittsburgh; Herman Veeder, Plattsburg, N. Y.; S. T. Wellman, Cleveland, O.; Professor C. O. Thompson, Worcester, Mass.; P. W. Shaefer, Pottsville, Pa.; M. D. Valentine, Woodbridge, N. J.; Samuel Thomas, Catasauqua, Pa.; Professor B. F. Silliman New Haven, Conn.; Edwin Thomas, Columbia, Pa.; John M. Sherrerd, Hudson County, N. J.; Jas. Thomas, Catasauqua, Pa.; F. J. Slade, Trenton, N. J.; Edmund C. Pechin, Cleveland, O.; Professor R. H. Richards, Boston, Mass.; William P. Shinn, Pittsburgh; Ellen H. Richards, Boston, Mass.; Edward M. Parrott, Wayne County, N. Y.; William Metcalf, Pittsburgh; Ed. V. McCandless, Pittsburgh; Charles O. Parsons, Boston; C. W. Kempton, Boston; Louis Janin, San Francisco, Cal.; Henry D. Hibbard, Nashua, N. H.; R. W. Raymond, N. Y.; I. P. Pardee, Hudson County, N. J.; Professor Henry S. Monroe, N. Y.; James Park, Jr., Pittsburgh; George C. Muson, Silver Cliff, Col.; Thomas McNair, Hazleton, Pa.; William Kent, Pittsburgh; A. L. Holley, N. Y.; Edward Gridley, Dutchess County, N. Y.; Michael Fackenthall, Hellertown, Pa.; Professor Thomas Egleston, New York; Alexander P. Coxe, Luzerne County, Pa.; James C. Bayles, New York; E. F. Eurich, Alleghany County, Pa.; S. W. Baldwin, Yonkers, N. Y.; W. B. Cogswell, Syracuse, N. Y.; Fred H. Daniels, Worcester, Mass.; John L. Gill, Jr., Pittsburgh; S. Alfred Ford, Pittsburgh; G. Clinton Gardner, Greenfield, Mass.; George H. Frost, New York; Oswald J Heinrich, Luzerne County, Pa.; Charles F. Manness, Scranton, Pa.; Charles MacDonald, New York; William Lilly, Mauch Chunk, Pa.

At 9 a. m. on the 16th, the members, with a number of invited guests, left the depot at Thirteenth and Callowhill streets, and proceeded direct to the Pencoyd Iron Works, where a stop of 45 minutes was made to allow the party to examine the several departments. The Midvale Steel Works, at Nicetown, were also inspected with interest, after which the visitors were taken to Malvern on the Pennsylvania Railroad. At this point about twenty-five of the party left the train and were transported in vehicles to Bishop's Platinum Works, the only establishment of the kind in this country. Here the interesting process of platinum melting was watched with undivided interest by the scientists. In the meantime, however, those remaining on the train were carried up to Downingtown, a distance of thirty-two miles, and then brought back to Malvern in time to allow the others to rejoin them.

When the Thirty-second street depot was reached the cars were switched to the elevated road, and the first trip over that structure was begun. The passengers alighted at Fifteenth street, and after visiting the public buildings, held a business session in the hall of the American Philosophical Society.

The session was opened with the reading of a paper on the Construction of Geological Cross Sections, by H. Martyn Chance, of Philadelphia, in which he briefly illustrated the various methods employed in locating section lines and underground curves. He was succeeded by Charles H. Ashburner, of Philadelphia, who read an interesting paper on a New Method of Mapping the Anthracite Coal Fields of Pennsylvania. Mr. Ashburner

explained that his plan of mapping had received the approval of the most eminent geologists, and that it was destined to take the place of all others now in use. By his system maps can be published bearing not only cities, towns, railroads and coal districts, but also all the underground features of coal mines, such as coal beds, the area of mines in use and those as yet unexplored, contour lines from mine data, the area of coal basins, depths of coal mines with the absolute area of coal lands now being worked and those as yet undeveloped. In conclusion he explained that he was enabled to perfect his maps by surveying the country on a scale of 300 feet to the inch vertically and horizontally.

Charles H. Morgan and Charles O. Thompson, of Worcester, Mass., followed with papers describing the use and action of common salt in wire drawing. In making iron and steel wire the papers explained it is necessary to have thorough lubrication to prevent abrasion. For many years a paste of rye has been used to furnish this lubrication, and was found to operate well enough until it was applied to Bessemer steel, which demonstrated its unfitness as a lubricator. As a result experiments were tried which resulted in the discovery that common salt and lime-water, at a boiling temperature, were found to answer all the necessary requirements. After the reading of two papers by S. A. Ford, of Pittsburgh, the Institute adjourned to attend a musical reception at the Academy of Fine Arts.

The Academy was beautifully decorated with choice flowers and plants on the occasion of the musical reception tendered by the Philadelphia Mining Engineers, to the visiting members and their wives. At the head of the stairs the visitors were received by the Citizen's Reception Committee, consisting of A. J. Drexel, George W. Childs, Dr. S. Weir Mitchell, Fairman Rogers and Persifor Frazer. Mrs. Mitchell, Mrs. Rogers and Mrs. Frazer also assisted in the reception. Stationed in the center of the eastern gallery was Mark Hassler's orchestra, which rendered a number of selections from both the old and new masters. Handsomely engraved programmes were distributed, bearing on the face the coat-of-arms of the Institute of Mining Engineers and on the back their elaborate monogram. During the evening several hundred ladies and gentlemen attended the reception, and the whole affair was very enjoyable.

(TO BE CONTINUED).

PERSONAL.

It is stated that Mr. Sutro, of tunnel fame, will soon make a tour of Europe.

The following gentlemen have resigned from the World's Fair Commission: John A. Stewart, Abram S. Hewitt, Daniel F. Appleton, David Dows, Orestes Cleveland, Horace Porter, Henry M. Alexander, Fletcher Harper, Charles G. Francklyn, Thomas C. Acton, Jackson S. Schultz, Edward Clark, William B. Dinsmore, Dennis C. Wilcox, Benjamin B. Sherman, Samuel B. H. Vance and Henry Hilton.

ENGINEERING ABROAD.

[From our own Correspondent]

PARIS, Feb. 2.

Between canal cutting and dykes, the engineer of the period can hardly fall out with water, even in the wrong place, since it contributes such a large contingent of "business." The Panama Canal is, of course, the most prominent work at present, and the departure of so many of our engineers has given it a reality. A banquet given to M. Lesseps, a few days ago, gave that gentleman another opportunity of recounting the history of the Panama project. Very little information not already known was given, but the seven thousand shareholders present seemed to be satisfied.

THE RHONE AND MARSEILLES CANAL.

The project of joining the port of Marseilles with the Rhone, by means of a large canal, will doubtless be adopted by the local Conseil. As the Rhone is to be widened and regulated, a great progress will be made in bringing vessels further into the interior of the country. The plan adopted makes the canal begin at the foreport north of Marseilles harbor, and then follows the sea coast to Lave, where it enters a tunnel in the mountains for a distance of seven kilometers 476 meters. After utilizing various small canals, it would merge into the Canal du Roi, the canal at Coronte and the maritime canal from Arles to Bone as far as Galegeon, and then follow straight to the Rhone at Bras Mort, where there is a lock. The total length would be 54 kilometers 496 meters. The level would be that of the sea, and the difference of level between that of the Rhone and the sea would be equalized by two sluices, while a third would prevent the currents likely to be met with in the sea canal at Berre. The general width is to be 46 meters, but in some cuttings and in the tunnel the width would be only 17 meters. The tow-path and foot-path in the latter would be respectively 3 meters and 1 meter 50. The entire cost is fixed at 73 million francs. Another engineer placed it at only 65 millions. The tunnel alone would cost 32 millions. The insalubrity of the country in the neighborhood of Port St. Louis has called forth a criticism, for the marshes have always rendered that engineering work of little practical benefit. Some objections are also made to having Bras Mort as a feeder, but the engineer pointed out that no better place could be found, as it was essential that the junction of a river and canal should be made with a concave curve to the current. The enlargement of the canal from Arles to Bone, which formed part of another project, will hardly be adopted.

IRRIGATION—REMOVING BARS.

Spain offers a large field for engineering, especially for works of irrigation. A hydraulic elevator, put up by a French house, has been found very satisfactory. The grounds are in some cases 13 meters above the river. A Fontaine turbine has been used as the motive power. Despite the difference between the chute and the head, a very regular working has been attained.

A patent has been taken out for removing bars at mouths of rivers, and for deepening channels by means of dynamite, or other explosive. A flexible and impermeable bag is filled with dynamite and sunk at required place. It is then discharged by electricity. It is thought that taking advantage of the time, when the tide is going out strong, a great deal of the sand and disintegrated matter will be carried away. By means of parallel tubes, a greater effect can, of course, be obtained.

The demolishment of a mass of cast-iron by dynamite is rather a new application of the explosive *par excellence*. A new blast furnace was to be built at Frouard; but the contractor found an enormous block of iron, nearly ten feet in diameter, and as many in height, blocking up the old furnace. Every method to break it up having failed, it was resolved to employ dynamite. The first bore was made to the depth of 39 inches, and charged with about 800 grams of dynamite. The first discharge ruptured the mass into three parts, and other blastings completed the work. The new dynamite gum was used, but not exclusively, owing to the uncertain nature of the discharge. It was therefore deemed better to intercalate ordinary dynamite with two or three layers of the gelatine charges, thus insuring the explosion. Despite the enormous power which was requisite, there was no projectile force. This very same system has been successfully employed in leveling down houses, thus saving a great deal of expense and time—800 cubic meters of masonry have been leveled in Paris by one blast without a single projectile.

THE GERMAN ELECTRIC TECHNICAL SOCIETY.

This Society, under the presidency of Dr. Werner Siemens, has now 1,504 members, and is rapidly extending its membership. Its seat is in Berlin, but every country, and every walk and condition of life, have representatives in this "Verein." Electricity is considered by some in its infancy, so far as its application to industrial purposes is concerned, and this fact is calling the attention of inventors and scientific men to it more and more every day.

NOTES ON THE ACTION OF FURNACES, BOILERS AND STEAM ENGINES.

(*Continued from page* 43.)

IV.

CHIMNEY, FURNACE AND BOILER.

The dimensions of the chimney, taken in connection with the area of the grate and the surface of fuel exposed to the action of the air, are the principal elements on which the quantity of fuel burned in a given time depends. The proper proportion between the grate surface and the heating surface depends upon the initial temperature of the gases, and this initial temperature varies with the rate of combustion: hence the height of the chimney indirectly enters into this proportion. The draught of a chimney is caused by the difference of pressure at the base of the chimney acting upwards, due to the difference between the weight of the heated gases in the chimney and a column of the external air of equal height and cross-section.

If h = height of chimney; d = density of external air; and d' = density of heated gas,

$$p = h\,d - h\,d' = h\,(d - d').$$

$\frac{p}{d} = h\,\frac{d - d'}{d}$ = height of column of air which would produce this pressure, $= \frac{v^2}{2g}$ if there were no frictional resistances. Here v denotes the velocity in feet per second acquired by a body moving through the height h under constant acceleration g, which is that due to gravity; $g = 32.2$. Then

$$v = \sqrt{\left(2\,g\,h\,\frac{d - d'}{d}\right)}.$$

The gases experience resistance in passing through the grate, fuel, flues and chimney itself. In some experiments the velocity of the gas in chimneys of 33 ft., 66 ft. and 98 ft. has been found to be 5.1 ft., 8 ft. and 9.1 ft. per second, or 18360 ft., 28800 ft. and 32760 ft. per hour. These velocities, divided by the number of cubic feet of air required to burn one pound of fuel, will give the quantity of fuel burned per hour for each square foot of section of chimney flue. It may be laid down as a practical rule, that, to insure the best possible draught through a given chimney, the temperature in the chimney should be nearly sufficient to melt lead, say 600° F., but when the furnace is not forced the temperature is often much lower. As the proper allowance of air is generally 24 lbs. to each pound of fuel, the volume of the hot chimney gas at 600° F. is about 650 cu. ft. per lb. of fuel, or 26 cu. ft. per lb. of air.

The ratio of grate surface to the section of the chimney may be 8 to 1.

The quantity of heat transmitted through the plates of the boiler, flues, etc., depends upon the extent of surface and the difference of temperature between the water in the boiler and the burning fuel and hot gases. The extent of the heating surface is fixed with reference to the initial temperatures of furnace and gases, and therefore depends upon the rate of combustion to be employed. It must also

be proportioned to the absolute quantity of fuel burned in a given time, or in other words, to the grate surface. The grate surface being unity, the heating surfaces in different types of boiler, usually average in plain cylinder boilers 12, Cornish boilers 35, cylinder flue 21, cylinder tubular 28, portable 32, locomotive 75. The rate of combustion per hour per square foot of grate in ordinary practice is given by Rankine as in Cornish boilers from 4 to 10 lbs. per hour, under factory boilers 12 to 16 lbs. per hour, locomotives from 40 to 120 lbs. per hour.

The amount of heating surface required to evaporate 1 cu. ft. of water per hour at 212° is, for plain cylinder boilers, 8.8 sq. ft.; double flue Cornish, 11.7 sq. ft.; marine tubular, 14 sq. ft. A rough rule has sometimes been quoted, that boilers for stationary engines require one square foot of grate surface, one square yard of heating surface, and one cubic yard capacity for each horse-power, and that each horse-power requires the evaporation of one cubic foot of water per hour. The practice of the Navy Department is to allow 8 lbs. anthracite coal per hour to evaporate one cubic foot of water at 212°, under 30 lbs. per sq. inch, which requires $\frac{3}{5}$ sq. ft. of grate and $16\frac{2}{3}$ sq. ft. of heating surface. The quantity of water evaporated per pound of coal for the plain cylinder boiler, the cylinder flue and the cylinder tubular boiler is, under favorable circumstances, 7, 8 and 9 lbs. of water to 1 lb. of coal.

The efficiency of evaporation is affected by the rate of combustion and the rate of transfer of heat. The former is influenced by the temperature of the external air, the temperature of the chimney gas, the presence of moisture in the air, the management of the fires, the quality of the fuel and the perfection of the combustion; the latter by the rate of combustion, the temperature of the water, the accumulation of incrustation and dirt.

Boilers should have strength to resist internal pressures, durability, economy in evaporating qualities, economy of materials and workmanship, adaptation to place.

The fall which the pressure of steam undergoes in passing from the boiler to the cylinder is due to the following causes: The resistance of the steam pipe; the resistance of the regulator or throttle-valve; the resistance of ports, at times partially closed; the escape of heat through the steam pipe; the disappearance of actual energy when steam passes from the ports to the cylinder, exchanging its previous rapid motion for the comparatively slow motion of the piston. If the velocity of steam in the steam pipe does not exceed 100 feet per second, the resistance of the pipe may be neglected. Wire drawing may superheat the steam by friction, and consequently there is not entire waste of energy.

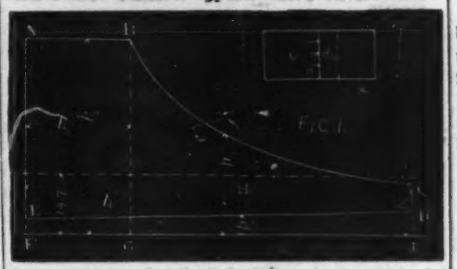
V.

ACTION OF STEAM ON A RECIPROCATING PISTON.

In finding the expression for the work of the steam on the piston, it will be supposed that, during expansion, the pressure of the steam varies according to Mariotte's or Boyle's law, that is, that pressure exerted by a gas is in the inverse ratio to its volume; the temperature remaining constant. If p_0 = and v_0 are the initial pressure and volume, and p and v any other pressure and its corresponding volume; this law will be represented by the formula $pv = p_0 v_0 = a$ constant.

A=area of piston in sq. inches; H=length of stroke of piston in feet; h_0=portion of stroke passed over during admission of steam at p_0 per sq. inch; h=distance to point of stroke where pressure is p; p_1=pressure at latter endof stroke; p_2=back pressure on other side of piston by vapor in the condenser, or by the exhaust into atmosphere if there is no condensation; E=energy or work of steam for one stroke of the piston.

The theoretical diagram supposed to be traced by an indicator will then be represented by the figure here drawn. The back pressure line, $D\,E$, is assumed to be straight, so that p_2 is the mean ordinate, if not constant. The dotted line is the atmospheric line, say 14.7 lbs. above the base line or axis. In a high-pressure engine this line will come below the diagram. Length of stroke = $F\,I$; point of cut-off at G.



The work of the steam before cut-off equals area of rectangle, $A\,B\,G\,F \times$ area of piston $= p_0\,A\,h_0$.

The work of the steam between point of cut off and end of stroke, or from G to I equals area $B\,C\,I\,G \times A$. To find this area: If gas at pressure p and volume v increases its volume to $v + d\,v$, the work of increase $= p\,d\,v$. Then if the volume and pressure are changed from v_0 and p_0 to v_1 and p_1, the total work $= \int_{p_0}^{p_1} p\,d\,v$. But, by Marriote's law $p\,v = p_0\,v_0$, or $p = \frac{p_0\,v_0}{v}$; therefore,

$$\text{Work of expansion} = p_0\,v_0 \int_{v_0}^{v_1} \frac{d\,v}{v} = p_0\,v_0\,(log.\ v_1 - log.\ v_0) = p_0\,v_0\,log.\ \frac{v_1}{v_0}.$$

Since $\frac{v_1}{v_0} = \frac{p_0}{p_1}$; and in this case $v_0 = A\,h_0$, we have

$$\text{Work during expansion} = p_0\,A\,h_0\,log.\ \frac{p_0}{p_1}.$$

The opposing work of back pressure $= -p_2\,A\,H$. Therefore the work of one stroke

$$E = p_0\,A\,h_0\left(1 + log.\ \frac{p_0}{p_1}\right) - p_2\,A\,H.$$

If V_0 = volume swept through by the piston during admission and V_1 = volume described by whole stroke,

$$A\,h_0 = V_0;\ A\,H = V_1;\ \frac{p_0}{p_1} = \frac{V_1}{V_0};\ \text{and } p_2\,A\,H = p_2\,V_1 = p_0\,V_0\,\frac{p_2\,V_1}{p_0\,V_0} = p_0\,V_0\,\frac{p_2}{p_1}.$$

Hence

$$I = p_0\,V_0\left(1 + log.\ \frac{V_1}{V_0} - \frac{p_2}{p_1}\right).$$

If the machine has no expansion, $V_1 = V_0$, and the logarithmic term disappears. If r = ratio of expansion, $\frac{V_1}{V_0} = r$, and

$$E = p_0\,V_0\left(1 + log.\ r - \frac{p_2}{p_1}\right).$$

If the *mean* forward pressure is denoted by p_m, we must have

$$p_m\,V_1 = p_0\,V_0\,(1 + log.\ r);\ \text{or } p_m = p_0\,\frac{1 + log.\ r}{r};$$

and, as before $p_2\,A\,H = p_2\,V_1$; therefore

$$E = (p_m - p_2)\,V_1.$$

The most convenient expression for E may be used in computation. Double this expression for one revolution of a double-acting engine, multiply by the number of revolutions per minute for the work of one minute, and divide by 33000 to obtain the probable indicated horse-power of the engine.

If there is no condenser, p_2 will be slightly above the atmospheric pressure, and may be called equal to from 15 lbs. to 17 lbs., in some cases more. This expansion curve is an equilateral hyperbola; a method for drawing it, when desired, on an indicator diagram, for comparison with any actual curve, will be given later.

The logarithms used here are Napeirian or hyperbolic logarithms, and may be obtained from common logarithms by multiplying the latter by 2.302,585, or practically in many cases by 2.3. The Napeirian logarithms of the first ten numbers are as follows:

log. 2 = 0.69315.	log. 7 = 1.94591.
" 3 = 1.09861.	" 8 = 2.07944.
" 4 = 1.38629.	" 9 = 2.19722.
" 5 = 1.60944.	" 10 = 2.302585.
" 6 = 1.79176.	

Example: A high-pressure, double-acting engine has a cylinder 12″ diameter, 2 ft. stroke; it makes 80 revolutions per minute and cuts off steam at $\frac{1}{4}$ stroke, boiler pressure is 35 lbs. above atmosphere. Find E and the horse-power.

Call $p_2 = 15$ lbs. $p_0 = 35 + 15 = 50$. Then

$$p_m = p_0\,\frac{1 + log.\ r}{r} = 50\,\frac{1 + 1.1}{3} = 35 \text{ lbs.}$$

$$E = (p_m - p_2)\,V_0 = (35 - 15)\,\frac{3.1416 \times 12^2}{4} \times 2 = 4524 \text{ ft. lbs.}^*$$

$$\text{Horse-power} = \frac{4524 \times 2 \times 80}{33000} = 21.9 \text{ H. P.}$$

VI.

WATER AND COAL REQUIRED—THE EXPANSION CURVES.

The quantity of water which must be evaporated to produce the work E of the last article, may be found as follows:

Let t_0 = temperature of the steam at p_0 lbs. on the square inch.

Let v_0 = volume of one pound of that steam.

Let V_0 = volume of steam used to point of cut-off;

Then the weight of water to produce V_0 volume of steam is

$$Q = \frac{V_0}{v_0}.$$

The volume of one pound of steam at temperature t_0 is given by the formula or table of Art. II.

In the example quoted before

$$V_0 = \tfrac{1}{4}\,V_1 = \frac{3.1416 \times 12^2 \times 2}{144 \times 4 \times 3} = 0.5236 \text{ cu. ft.}$$

$p_0 = 50$ lbs.; t_0, by previous table = 281°, and $v_0 = 8.35$ cu. ft.

Then $Q = \frac{0.5236}{8.35} = 0.063$ lbs.

Water used per hour = $Q \times 2 \times 80 \times 60 = 604.8$ lbs. = 9.7 cu. ft.

The amount of coal required to evaporate the water Q may then be found. The number of heat units required to convert one pound of water from the temperature of the feed, t_f, into steam at t_0, has been given as

$$1092 \times 0.3\,(t_0 - 32°) - (t_f - 32°)$$

If the feed-water temperature is 50° F., the heat units will be

$1092 \times 0.3\,(281 - 32) - (50 - 32) = 1148.7$ ht. units for 1 lb. water.

If it is supposed that the coal burned has 10 per cent. waste, that 60 per cent. of the heat is utilized, or obtained in the steam, and that a pound of coal theoretically yields 14500 heat units, we get $14500 \times .90 \times .60 = 7830$ ht. units from one pound coal.

$\frac{604.8 \times 1148.7}{7830} = 88.7$ lbs. coal used per hour.

Calling $Q = 0.06$ lb., the number of heat units imparted to $Q = .06 \times 1148.7 = 68.9$ ht. units, and the energy contained in that steam is $68.9 \times 772 = 53191$ ft. lbs.

The amount of work done by the engine was 4524 ft. lbs. Hence there was realized $\frac{4524}{53191}$, or $8\frac{1}{2}$

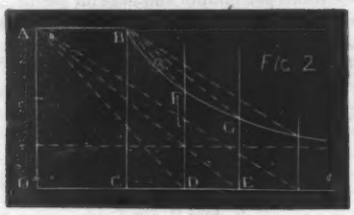
* As the pressure is expressed in pounds on the square inch, the area of the piston is found in square inches, but the stroke is expressed in feet, giving foot-pounds as the result.

per cent. of the energy imparted to the steam, and about 5 per cent. of the energy in the fuel used.

But the steam was released at atmospheric pressure, or 212° F. It therefore contained at that time

$$1092 \times 0.3\,(212-32)-(50-32)=1128$$

of the heat-units imparted to the water originally. Some of this heat might be saved by using the exhaust steam to heat the feed water. Had a condenser been used, p_2 would have been much less, and the efficiency would have been increased. The engine would, however, be more complicated and expensive in first cost and maintenance.



To construct the expansion curve on any indicator diagram, or to find the theoretical curve for the equation pv = constant:

Let $O\,E$ be the line of no pressure, A the point on the diagram, which corresponds with the beginning of the stroke or zero volume, $O\,A$ the initial pressure, $A\,B$ the line for full steam, and B the point of cut-off; draw any number of vertical lines, $D\,F$, $E\,G$, etc., at convenient distances. Draw through B, $B\,F$ parallel to $A\,D$; the point F, where $B\,F$ cuts $D\,F$, will be a point in the curve; the point G is found where $B\,G$, parallel to $A\,E$ cuts $E\,G$, and so on. In short, a line is drawn from A to the foot of any vertical; a parallel line through B determines the point where the desired expansion curve cuts that vertical.

Nearly all engines work expansively, and it is generally impracticable to ascertain theoretically, except as an approximation, the condition of the steam, and hence the quantity of work which an actual engine under given conditions is actually exerting. The only true resource is the indicator. The indicator traces a curve which takes very nearly the form of the equilateral hyperbola, and the latter is almost universally applied to indicator cords as a test of the action of the steam.

THE PANAMA ENGINEERS.

The following is the constitution of the corps of engineers engaged on the Panama Canal works:

Superior Council.—Réclus, head agent; Verbrugghe, chief of arbitration department; De Cazenave, engineer of the technical department; Nathanson, engineer; Thome, book-keeper; Guignard, secretary to the head engineer; Trufley, secretary to the arbitration department; Le Mat, accountant.

Department of Works.—G. Blanchet, head of service; Clavenade, engineer, head of the technical department; Roux, engineer, director of sounding; Chamberlaine-Bey, secretary; Louis David, cashier; Boiseau, store-keeper; H. Lambert, shipper; T. Puiseux, draughtsman; A. Danthon, accountant.

First Brigade.—J. L. Weber, acting head of brigade; P. Marolle, sub-chief; Elie Adam, director; C. Sonderegger, draughtsman; Parent, camp superintendent; G. Meugniot, flagman; Brocard, chairman.

Second Brigade.—Morel, chief; La Fontan, sub-chief; Van de Patte, conductor; A. Martel, camp superintendent; C. Marolle, flagman; L. Assire, chairman; Duchez, carpenter.

Land Service.—Harel, agent; Carcenac and Delisle, health department; attachés, Companyo, Pidoux, etc.

SURVEYING, LAYING OUT AND MONUMENTING THE NEW WARDS OF NEW YORK.

II.

BY S. S. HAIGHT, CIVIL ENGINEER AND CITY SURVEYOR, WEST FARMS, N. Y.

With this chain (its length adjusted to the temperature at the time of using, used always level and always with the same tension), surveys have been made when the temperature has been below Fahrenheit's zero, and connected with others made when the mercury has stood above one hundred degrees; yet calculation has shown the closing to be within the prescribed limit of one inch and seven-eighths for each thousand feet of traverse measured.*

For the invention of the flattened wire to be used in combination with the temperature adjustment, the profession is indebted to the present Chief-Engineer of the New York Dock Department, who had three contracts with the Park Commissioners for topographical surveys. This gentleman (Mr. George S. Greene, Jr.) had previously been the principal assistant of Mr. S. D. V. Mason, the contractor for the Morrisania surveys.

Mr. Thomas C. Cornell, of Yonkers, and Mr. William Rumble, of Morrisania, also had each three contracts with the Department. The requirements of these contracts were nearly similar, and may be briefly stated as follows:

Traverse lines were to be run parallel to, and at right angles with, the base at every eight hundred or one thousand feet each way, stakes being set on these lines at every one hundred feet, and locust posts at the intersections of the traverse lines and such intermediate points as might be made necessary by the nature of the ground, small nails or pins being driven in these stakes, or posts, to mark the points.

Where these points, or posts, came on rock, iron bolts were set in by melted sulphur, and a cross-cut upon the head.

Traverses were also to be run through all streets or roads, and around all separate properties exceeding a certain small area, and also along water courses.

In measuring these traverses, all buildings, fences, streams and prominent topographical features were to be noted.

Levels were required at every fifty feet in distance along these traverses, giving the altitude above high-water in the Harlem River at each of these points, and at each corner of every one hundred feet square throughout the territory. In addition levels were required at all places of abrupt changes in altitude. Maps were to be made on a scale of eighty feet to the inch, on good mounted paper, in sheets thirty by thirty-two inches.

Each sheet would thus show one hundred and twenty-five acres within a sufficiently wide border. These maps were required to be neatly and plainly made, and to show the entire results of the surveys in a manner specified particularly for nearly all its features. The lengths of all traverse lines, and the size of every angle measured being given upon the maps, enabled the Department engineers to calculate all circuits to see that they closed within the prescribed limit of accuracy.

The corners of the 100-feet squares were located for taking the levels by ranging in from the stakes on the inclosing traverse lines, care being taken to keep the nomenclature perfect, so that the positions of these points and of all topographical features, buildings, line fences, etc., could be correctly shown upon the maps.

As fast as these maps were completed they were signed by the contracting surveyor, and delivered to the commissioners at the Department office, 265 Broadway.

The maps were then subjected to a rigid examination by the Department engineers, and all traverses were calculated: if not found in accordance with the specifications, they were returned to the contractors for correction, but if found correct, they were marked as accepted, and their areas calculated; as the prices named in all the contracts were by the acre.

The maps made of the territory that was surveyed directly by the Department engineers, were of a smaller size than those made by the contractors, but the change of size was not found to be an improvement.

The sheets of the Morrisania survey were considerably larger than those made by the department contractors, and were on a scale of one hundred feet to one inch. After the completion of several of the contracts, it was found that the monuments that had been used as the base, were not on the true east line of Tenth avenue; and that the rods known as "Central Park standard" were about a quarter of an inch longer than United States standard fifty feet. For the last contract, and for the surveys made directly by the Department, a calculated correction was made and established upon the ground, so as to use the true Tenth avenue line for a base.

Advantage was afterward taken of the presence in Central Park of a party engaged in the "United States Coast Survey," with their instruments; and two stone monuments were placed below the floor of the Department carpenter shop, with metal plates set firmly in the stone. Fine cuts were made upon these plates in the form of a rectangular cross, the utmost care being taken that the intersection of the cuts upon one plate should be precisely fifty feet from that upon the other; the United States standard instruments being used for the work, which was performed under the supervision of one of the ablest engineers at that time in the service of the Department, Mr. John Bogart, Secretary of the American Society of Civil Engineers.

Cuts were also made upon the heads of nails driven in the floor in line with the monuments midway between them and at five feet on each side of the middle. Since then all the department chains have been tested by this standard, and have been corrected to agree with it when found erroneous. These monuments being so situated as never to be affected by either frost, storm or heat of the sun, and with but small variation of temperature, will hold permanently what is believed to be a reliable United States standard fifty feet.

* Working with the truss rods was much more laborious than with the chain, and required more time for measuring an equal distance, but enabled a closer degree of accuracy to be attained. In the surveys by the department engineers before the rods were discarded, a block, the sides of which measured one and three-fourths miles in aggregate length, closed with an error of only one and one-eighth inches; the closing line and distance of the rectangle both coming upon the stake of starting. Another rectangular block of three-quarters of a mile aggregate length of sides closed upon the starting stake with an error of five-eighths of an inch.

Although such extreme accuracy is not practicable with the chain, it is rarely the case that any remeasurements have to be made to close circuits within the prescribed limits.

MEXICAN CORRESPONDENCE.

CITY OF MEXICO, Jan. 24, 1881.

Every steamer brings to these shores Americans bent on pleasure or speculation. The hotels are full to overflowing. Two new American boarding-houses (new institutions in Mexico) have recently been opened, and we observe in many stores now the signs: "English Spoken Here."

During the month of December 101 persons died of yellow fever in Vera Cruz, but now the city is healthy. The constant arrival of railroad materials at that post gives life to the town. As a sample of the increased trade, the last Alexandre steamer brought 3,188 cases of railroad material for the Palmer-Sullivan Railroad alone, and for three months past the Alexandres have been landing more freight of that kind than the Vera Cruz Railroad Company have been able to transport, notwithstanding the fact that extra freight trains have been put on.

Mr. Miller, Chief Locating Engineer of the Palmer-Sullivan road, left Mexico City for Laredo yesterday morning. He remarked to your corre-

spondent: "I think we will be able to commence that end of the road in about seven weeks."

Mr. Sullivan has gone to Morelia, where we learn the Governor and other officials propose to give him a public reception and ball, by way of expressing their respect for the energy he has shown in railroad matters. His engineers commenced work there on the 14th inst.

The reception at the American Legation last Tuesday was largely attended. Judge Morgan and family are extending their acquaintance with Mexican families, and are extremely popular.

Young Harry Morgan, son of the American Minister, left for Trojes on the 19th instant with the intention of devoting himself to the study of mining engineering. His departure is deeply regretted by the young American colonists, especially by the Shakespeare Club.—*N. Y. World.*

MINUTES OF THE SECOND ANNUAL MEETING OF THE ASSOCIATION OF COUNTY SURVEYORS OF THE STATE OF OHIO.*

WEDNESDAY, JANUARY 12, 1881.

In accordance with the constitution of the Association of County Surveyors of the State of Ohio, a large number assembled at Columbus on this date, and were by the kindness of the Auditor of State allowed to occupy room No. 2 of the capitol building.

The Association was called to order at 2:30 p. m., President Paul in the chair, all the other officers and a majority of the standing committees being present.

Remarks were made by a number present, and letters and dispatches from those absent were read. The bill submitted by the committee on legislation to the Ohio Legislature was then called up and read, and discussed by sections.

Resolution by Mr. Bowen, of Franklin County.

Resolved, That the president appoint three additional members to assist the legislative committee during the present session of the convention.

Resolution by Mr. C. W. Shoemaker, of Lucas County:

Resolved, That the president be requested to appoint a committee to take charge of the press reports of the proceedings of this Association.

On motion of F. J. Sager, of Union County, a committee of five were appointed by the president, to whom were referred questions on county work and official duties.

On motion of L. B. Denison, of Delaware County, a committee of five were appointed by the president, known as the committee on statutes in force and fees, and authorized to refer such questions as they may deem necessary to the Secretary of State and the Attorney General.

On motion of F. J. Sager, of Union County, a committee of three were appointed to prepare a programme and order of business for the present session.

The president reported the names for the following committees:

Additional to the Legislative Committee.—P. N. Jonte, Hamilton County; J. B. Gregory, Scioto County; E. B. Opdyke, Williams County.

Committee on Press Reports.—B. F. Bowen, Franklin County; L. B. Denison, Delaware County; Fred Howell, Muskingum County.

Committee on County Work and Official Duties.—C. Dawson, Belmont County; J. F. Buck, Morrow County; J. Arnett, Madison County; F. J. Sager, Union County; Frank A. Bone, Warren County.

Committee on Statutes in Force and Fees.—C. W. Shoemaker, Lucas County; E. D. Shaw, Carroll County; J. N. Headington, Knox County; John Hiller, Montgomery County; Geo. Fallon, Athens County.

Committee on Present Programme.—F. J. Sager, Union County; Elwin Phifer, Hancock County; John Craig, Auglaize County.

On motion, the Association adjourned to meet at 8 p. m.

JANUARY 12, 8 P M.

Convention met pursuant to adjournment, President Paul in the chair.

The discussion of the bill now before the legislature was resumed, remarks were made by a number of the members and all were called upon to give their opinion.

On motion, a recess of 20 minutes was taken, in order that the committee on legislation might make their report of changes considered necessary. On reassembling, the bill was read and received the approval of the Association.

Mr. Fred Howell, of Muskingum County, then read a paper illustrating the necessity of the preservation and advocating the maintenance of the office of county surveyor.

On motion, it was ordered that Mr. Howell's paper be incorporated in the proceedings of this Association, and a vote of thanks was tendered him for its production.

Association adjourned, to meet 9 a. m., Jan 13.

* Held in room No. 2, Capitol Building, Columbus, Ohio Jan. 12, 13 and 14, 1881.

JANUARY 13, 9:30 A. M.

The Association of County Surveyors was called to order at 9:30 a. m.

The following resolution was offered by Mr. B. Thompson:

That there be appointed by the president a committee of five, to whom shall be referred the matter of official blanks and field books for the use of the offices of county surveyor. Adopted.

President appointed J. B. Strawn, Columbiana County; D. D. Ames, Wood County; W. H. Brown, Hardin County; B. Thompson, Champaign County; Jacob Greek, Wyandot County.

A resolution by Mr. White, of Gallia County, provided that a committee of five be appointed by the chair, to whom matters pertaining to instruments and standards of measure be referred. Adopted, and committee appointed for same, consisting of C. H. Burgess, Cuyahoga County; L. B. Denison, Delaware County; F. J. Sager, Union County; P. N. Jonte, Hamilton County; Wm. R. White, Gallia County.

The Association then listened to a paper by Mr. Sager, of Union County, upon the subject, "Ohio's Civil Boundaries, Past, Present and Future." A vote of thanks was tendered Mr. Sager for his valuable paper, and the committee having in charge the annual report were requested to incorporate the same in full. Before adjournment the following resolution was offered by Mr. Arnett, of Madison County:

Whereas, The monuments marking the lines and corners of the lands of the several counties in this State, and especially in the "Virginia Military District," are fast perishing and disappearing from various causes; and, whereas the original surveys, especially in said "District" were, from various reasons, imperfectly taken, rendering it almost impossible for the surveyors to restake them; and, whereas the subdivisions of said surveys, especially in said "District," largely ignore in their call the orginal lines and corners; and, whereas in the transfer of land upon the auditors' duplicate much confusion exists,

Resolved, Therefore, that it should be the duty of each and all county surveyors throughout the State (believing it to be to the best interest of our land system) to bring before their county officers, land holders and others, the proposition for a law whereby a resurvey of the State of Ohio can be made. First, by running a system of triangulation on a large scale over the entire State, upon the principle of the U. S. Geodetic and Coast Survey; then filling in by a subordinate system as low down as township lines, and finally filling in and completing the work by the local surveyor, and that the original surveys and plats be merged in a book, prepared for the purpose, to show where they belong.

Referred to the committee on legislation. Adjourned to meet at 2 p. m.

JANUARY 13, 2 P. M.

Association was called to order, pursuant to adjournment, at 2 o'clock p. m. As was previously announced, Mr. B. F. Bowen, of Franklin County, read a very interesting paper on the subject of "Bridges." At the conclusion of the reading of this paper, the following resolution was offered and adopted:

Whereas, The laws of this State make the county surveyor one of the county board to adopt plans for "highway bridges."

Resolved, That it is necessary that county surveyors should be familiar with the methods of computing their strength, as well as competent to judge of designs, and that the thanks of this Association are due Mr. Bowen for his efforts in this direction, and that he be requested to illustrate some of his formulæ for computing truss strains at this evening session.

Next followed the discussion of methods of protracting or platting surveys, which was generally participated in by the members. Some new and ingenious methods were brought out.

Information was next submitted in response to the question of the cost of establishing meridian lines in these counties where the same have been established according to the provisions of law; which revealed the fact that it had generally cost from $150 to $300, in some cases from $600 to $1,000. Mr. Burgess stated that a skillful use of a first-class engineer's transit would give a meridian line with a possible variation of 10 seconds of arc.

On motion society adjourned to meet at 8 p. m.

JANUARY 13, 8 P. M.

Evening session was called to order by President Paul at 8 p. m. Mr. Bowen presented strain struts, diagrams and formulæ illustrating his general method of computing strains in trusses. The evening was profitably employed, and much interest manifested—the entire evening being devoted to discussion of similar methods.

On motion Association adjourned to meet at 9 a. m., Jan. 14.

JANUARY 14, MORNING SESSION.

Pursuant to adjournment the Association was called to order by First Vice-President Bowen at 9:30 a. m. The annual report of the treasurer and executive committee was heard. It now being the hour announced in the programme for Mr. J. B. Strawn, the member from Columbiana County, he then read his paper on "Magnetic Variation," and was tendered a vote of thanks by the Association for so much instruction and entertainment, and the committee on annual report was requested to preserve the same in the report.

The following resolutions were offered and adopted:

Resolved, That a committee of three be appointed to secure from the Secretary of State the instructions due from him to the county surveyors by Sec. No. 131 Revised Statues of the State of Ohio. Adjourned until 2 p. m.

JUNE 14, 2:30 P. M.

Association was called to order by the president.

The committee on county affairs and official duties offered their report. On motion the queries submitted to them were referred to the secretary and committee on annual report, with instructions that such ones as they may deem of sufficient interest be inserted in the next annual report, and also in the programme of the next annual meeting for answers and discussion, and that the committee be discharged.

The committee on statutes in force and fees submitted their report, which was received, referred to committee on legislation and the committee discharged.

The following resolutions were received and adopted by the Association of County Surveyors.

Resolved, That it is the desire of this Convention that a law should be enacted requiring all land surveyors to possess a certificate of qualification from a board of examiners to be appointed by the Governor of the State.

Resolved, That the president of this Association consults its members at the present time or within a few days, and select such members as are willing and can be induced to prepare papers to be read at the next annual meeting.

Resolved, That the thanks of this Association are due to Secretary Barnes and Attorney-General Nash, and others, for the prompt and satisfactory manner in which they responded to queries proposed by this Association at its first meeting and for courtesies received from them and other State officials.

Resolved, That we, as an Association and as members, co-operate with Mr. J. B. Strawn in his efforts to secure facts and observations in regard to the variation and declination of the magnetic needle.

The following resolution was presented by Mr. J. B. Strawn:

Whereas, The law, as existing in the statutes of Ohio, requiring the establishment of meridians and determination of latitudes and longitudes, requires a precision of instrumental manipulation not attainable without the expenditure of large sums of money, and whereas the boards of commissioners of many counties of this State have temporarily refused to approve of such expenditures; therefore, be it

Resolved, That it is the earnest request of this Association that such boards of county commissioners, with the least possible delay, comply with that part of the statute authorizing the determination of the true meridian, in order that the county surveyor may avail himself of the same in carrying out the systematic series of observations upon the variation and declination of the magnetic needle contemplated under the auspices of this Association. Adopted.

Resolved, That a committee of three be appointed by the chair, who are to report at least ten days before our next session a permanent programme and order of business during each session of our next meeting. Chair appointed Messrs. L. B. Denison, Delaware County; F. J. Sager, Union County; W. C. Row, Pickaway County.

Resolved, That the recording secretary and the committee on legislation be appointed a committee to prepare the annual report and have printed 1,000 copies of the proceedings of this Association at this meeting.

Resolved, That it is the sense of this Association

that in making observations on the variation of the magnetic needle from the true meridian, and in taking the bearing of any important line that the hour of the day in which such observation or bearing was taken be noted in the records, and that it is further the sense of this Association that the use of the magnetic needle should be avoided as far as possible, and an angular instrument substituted in locating land lines and corners.

On motion the committees on instruments and on official blanks and field books were given time to prepare a report and refer the same to the committee on annual report.

On motion, the secretary was requested to obtain a copy of the decisions of Attorney General Pillars on page 1,221 of the Executive Document, Part 2, of 1879, and include the same in the annual report.

The following resolution was unanimously adopted by the Association:

Resolved, That the secretary be requested to invite Prof. Mendenhall, of the Ohio State University, to deliver an address before this Association at its annual meeting in 1882, upon the metric system, submitted by C. H. Burgess.

On motion, the Association proceeded to the election of officers for the ensuing year, with the following result:

OFFICERS—1881.

R. S. Paul, Akron, President.
B. F. Bowen, Columbus, 1st Vice-President.
F. Howell, Zanesville, 2d Vice-President.
L. B. Denison, Delaware, Corresponding Secretary.
C. H. Burgess, Cleveland, Recording Secretary and Treasurer.

COMMITTEES.

Executive Committee.—Geo. P. Webb, Newark; J. B. Strawn, Salem; Jonathan Arnett, New London; F. P. Stone, Springfield; C. W. Shoemaker, Toledo.

Committee on Legislation.—R. S. Paul, Akron; B. F. Bowen, Columbus; John B. Gregory, Portsmouth.

The following-named gentlemen were named by the president to prepare papers for the coming meeting: J. Arnett, John Newman, of Richland County; F. Howell, J. N. Headington, Edwin Phifer, George Fallon and Samuel Craig.

The following resolution was offered by Mr. Craig, of Auglaize County:

Whereas, The present success and prosperity of this Association are largely due to the persistent efforts of its officers; therefore, be it

Resolved, By the members of this Association, that to them are due our thanks.

The question was put by Mr. Sager, of Union, and unanimously adopted.

On motion, the annual adjournment was made, subject to the call of the president.

C. H. BURGESS,
Recording Secretary Association of County Surveyors of Ohio, Cleveland, Ohio.

REGISTER.

R. S. Paul, Summit County.
B. F. Bowen, Franklin County.
Frederick Howell, Muskingum County.
C. W. Shoemaker, Lucas County.
E. D. Shaw, Carroll County.
Edwin Phifer, Hancock County.
M. Putman, Jr., Sandusky County.
D. D. Ames, Wood.
L. B. Denison, Delaware, County.
E. B. Opdycke, Bryan, O.
J. P. Marsh, Bryan, O.
John B. Gregory, Scioto, O.
W. J. Jackson, Henry, O.
Chalkley Dawson, Belmont County.
A. R. Howell, Muskingum.
John Hiller, Montgomery.
J. N. Headington, Knox.
C. H. Burgess, Cuyahoga.
J. T. Buck, Mt. Gilead, Morrow.
W. H. Brown, Hardin.
J. Arnett, London, Madison County.
F. J. Sager, Union County.
Frank A. Bone, Warren County.
P. N. Jonte, Hamilton County.
Benj. Thompson, Champaign County.
George Fallon, Athens County.
Jacob Greek, Wyandot County.
Sam'l Craig, Auglaize County.
Wm. R. White, Gallia County.
Wm. B. Jones, Van Wert, O.
L. B. Mesnard, Huron County.
Evan C. Jones, Jackson County.
Jno. H. Hall, Canton, Stark County.
W. C. Rowe, Circleville, Pickaway County.
J. B. Strawn, Salem, Columbiana County.
George P. Webb, Newark, Licking County.
Ezra D. Shreve, Wooster, O.
F. P. Stern, Springfield, O.

Besides some dozen others that did not register, and about twenty communications from those whom illness and business detained.

The water was turned into the Butler street 36-inch main on the 9th, and if no break occurs the whole city of Pittsburgh will be supplied with water from the new works.

ADDITIONAL WIDTH OF GAUGE ON RAILROAD CURVES.*

BY THOMAS DOANE.

Some two or three years ago an inquiry was made through the *Railroad Gazette* as to making the gauge of railroad tracks wider upon curves than upon straight lines. The editor asked for information upon that subject, but, so far as I know, the matter has had no further attention, though it is a very important one.

As long ago as 1870, in laying track, I widened the gauge upon curves, but having turned over the road to the operating department upon its completion, I had no opportunity to further study the experiment, and have therefore remained silent.

During a recent visit to the road referred to, I learned something further about it, which may, perhaps, be interesting to the members of our society, certainly to those who have to do with railroads.

The experiment alluded to above was made upon the Burlington and Missouri River Railroad, in Nebraska.

Previous observation had shown me that, though the tracks upon the straight lines and upon the curves had been originally laid to the same gauge, the gauge upon the curves was soon widened out by use. I do not now remember whether my observation showed a movement of but one, or of both rails, but I concluded that the widening of gauge was due to the stiffness of car trucks, and their failure fully to traverse upon the curves, and not to centrifugal motion. If this were the fact, it would even then be probable that the exterior rail of the curve would suffer the greater movement. Simple stiffness of trucks would be likely to affect both rails equally, but adding to this influence that of centrifugal force, unless it be fully counteracted by difference of elevation, and the exterior rail would show the greater displacement.

This condition of things showed a want of fitness between the track and the rolling stock and a consequent unnecessary, if avoidable, wear and tear upon both, and a waste of motive power.

It seemed to me that if the moving trains were bound to take more room between the rails, that it would be better to give it to them at the first. Then the rails would be firmly seated and remain in their places. If this is not done, and the rails are laid to straight line, or close gauge, then the head of the rails will be forced apart, the rails will be tipped on to their outer edges, either cutting into the ties or pulling their interior spikes, or both, thus loosening and disjointing the whole permanent way. So long as the gauge remains too narrow for the trains, there must result from the friction between the wheel flanges and the rails great wear and destruction of both.

If the gauge of curves be made open and loose, the coning of wheels will be utilized.

And, further, an engine will haul a larger load than if the train is pinched between rails too closely laid.

And, what is perhaps of more importance than anything else, greater safety is secured upon a track with an open gauge, in which the rails are firmly secured in the places where they are to remain, than upon a loosened and deformed track.

Upon the main line of the Nebraska road, the curve of greatest radius is a 30′ curve, and of least radius a 3° 30′ curve. In laying track on all curves of less than 2°, the gauge was increased from straight line gauge ¼ inch, or to 4 feet 8¼ inches, and 2° curves and over were laid to a gauge of 4 feet 9 inches, being an increase of ½ an inch over straight line gauge. Three sets of gauges were furnished the section men, of the lengths stated above for the curves, with the usual straight line gauge of 4 feet 8½ inches, and the men were held to the use of them until the road was turned over to the operating department by the engineering and constructing department.

At that time a new road-master came in, who either did not understand or did not appreciate what had been done by his predecessors, and curved track was gradually brought to the straight line gauge of 4 feet 8½ inches.

Since this road-master left, the tracks upon the curves, while undergoing repairs, have been restored to their original gauges, and have so remained now for several years. The man now in charge says that the practice gives great satisfaction; that the tracks upon the curves are maintained in good condition, at very little expense; that the wear of rails is sensibly diminished; that the engines can haul a maximum load, and that *no accidents* have occurred from increasing the gauge.

I have been told that, on hearing of laying track with open gauge upon curves, the officers of the Atchison, Topeka & Santa Fe Railroad adopted the plan for their road.

As there was but one curve on the Nebraska road of shorter radius than that of a 3° curve, no attempts were made to widen gauge, more than the ¼ inch alluded to. I have no doubt, however, that it would be entirely safe and wise to widen to the extent of 1 inch, or slightly more. The tread of our railroad car wheels is sufficient to prevent the wheel from dropping from the rail even then, and if laid 1½ inches open, the tread of the wheel, as now made, would cover about all of the tread of the rail.

Since writing the above I have had occasion to refer to the matter of resistance of curves to trains; and in an article by Baron von Weber I find the subject of widening gauge on curves incidentally alluded to. I was therefore mistaken in saying that the matter had no further attention since the inquiry of the *Gazette* had been made, but as it did not appear under a head distinctly bringing the subject to notice, it may have escaped the eye of the original inquirer, as it did mine.

The experiments of Von Weber were made in 1876-7-8, and his article entitled "Train Resistance on Curves" appeared in the *Railroad Gazette* of June 11, 1880.

Item No. 9 of a summary of the above is as follows: A reduction of the additional width of gauge on curves customary on the Bavarian roads, one-half or more, contrary to expectation, caused an increase in the resistance. The additional width given on these roads is:

Radius in meters.	Radius in feet.	Degree of curve.	Additional width of gauge in meters.	Additional width of gauge in inches.
750 M.	2482 feet.	2° 18′	0.008 M.	0.32 inch.
550 "	1822 "	3° 9′	0.014 "	0.56 "
400 "	1320 "	4° 20′	0.020 "	0.80 "
300 "	993 "	5° 45′	0.025 "	1.00 "

This result, however, cannot as yet be considered as fully established. This is the end of the quotation.

It would seem, then, that the widening of curve gauge upon the railroads of Bavaria is now usual, but how far back the custom extends is not shown by Von Weber's article.

It appears from the experiments that the reducing of the additional width of gauge increased the resistance to the passage of trains. The converse would therefore be true, within certain limits, that an additional width of gauge would decrease the resistance. This is in accordance with my own theory and experience, and it is to be hoped engineers will give the matter further attention and experiment.

The gauge of the tracks of Bavarian railroads is not given in Von Weber's article; but presuming it to be not very different from the standard American of 4.71 feet, there seems to be a very close agreement between the additional widenings which I gave the curves of different degrees in 1870, and those which are now used on the Bavarian railroads.

If I had been living in a country or at a time when engineers were expected to think and work in metrical terms, there might have been a still closer agreement.

* Read before the Boston Society of Civil Engineers, Dec. 15, 1880.

THE PROTECTION OF WOOD AND IRON BY PARAFFINE.

Dr. Eugen Schal gives some interesting information on this subject in the *Würtembergische Gewerbeblatt*.

In chemical technology great difficulties sometimes arise when it is desired to manufacture on a large scale preparations which may be obtained with ease in the laboratory. In most cases the reason of this failure is the fact that in the manufacture the use of glass, porcelain, platinum, etc., which successfully resist the effects of the various chemical agents must be dispensed with, and cheaper and less easily breakable materials, such as iron, copper, lead, and wood substituted. Wood especially cannot be replaced by any other material in the wholesale preparation of muriatic lyes, although the same, according to the strength and temperature of the liquid, undergoes sometimes very rapid destruction.

Dr. Schal says he acquired this experience more particularly in 1874-77, in alizarine manufactories, and that he found in paraffine a means which effi-

ciently protects the wood against damp, acids and alkalis, and by which a great saving is affected. The wooden vessels used, especially tanks of pine wood, for boiling acid and alkaline lyes, as well as casks of oak of the heaviest weights, for separating acid alizarine lyes at a pressure of a half to two atmospheres, were generally totally rotten after a few months, but they lasted for two years when impregnated with paraffine.

Before treating with paraffine, however, the vessels must be thoroughly dried for about three weeks by leaving them in warm and dry air, in order to prepare the wood for the absorption of the paraffine solution in its pores. The latter solution is prepared in the following manner: A part of the paraffine is melted in a spacious metal vessel over a moderate fire, the mass being stirred, the boiler taken from the fire, best moved into the open air, stirred until the mass begins to congeal at the edge, and then about six parts of petroleum, ether, or sulphuret of carbon are poured in, and stirred until solution. The preparation is then put into vessels that may be hermetically closed, or it may be used at once. In preparing the paraffine solution great care must be exercised, as paraffine as well as petroleum ether or sulphuret of carbon especially are very inflammable, and as even the vapor of the two last-mentioned substances, if mixed with air, may give rise to dangerous explosions. Those substances must, therefore, be kept in a cool space, far from light or fire, and well stoppered.

The wood is best saturated in dry and warm weather, as then it dries more quickly, and a smaller quantity of the solving agent is necessary. In winter six parts of the solvent generally do not suffice. This proportion changes with the quality of the paraffine and temperature; paraffine solving with difficulty is better than the more readily soluble article. Vessels easy of access, such as tanks, tubs, etc., are coated in the open air with the solution as long as the wood will absorb it. The solvents evaporate very quickly, leaving the paraffine behind, so that two or three coatings may be laid on in succession. If the vessel is to be exceptionally well prepared, it is left for a day to dry, and then another layer of the paraffine given.

For vessels in which steam is used for boiling the liquids they contain, he applies after a few days a coating of oil varnish, because the melting-point of paraffine is below the boiling-point of water, and it is thus in time driven out of the pores by the water.

Instead of oil varnish, the vessels, after being well rubbed down, may also be coated with a thin solution of soluble glass, then dried, and washed with diluted hydrochloric acid. The silicic acid thus formed clogs up the pores from the outside, and provides a protection to the paraffine against the hot water. For vessels which are used only with a moderate heat or cold, the coating of paraffine suffices perfectly. The paraffine is hardly dissolved by diluted cold alcohol, is not poisonous, and may also probably be used with advantage for vessels for keeping liquid. In the case of barrels, the solution was poured in simply after drying them; for an oak barrel holding 9 to 10 hectoliters, 1 kilo of paraffine dissolved in petroleum ether was required. All openings were then well closed and the barrel rolled about and over for about an hour, so as to bring all parts in contact with the solution. The barrels were finally left standing on their ends for half a day, after which time the remainder not absorbed was emptied, and used for the outside coating. Before applying the solution outside, however, the barrels must be well cleaned, for dirt naturally closes the pores of the wood. As these barrels were very expensive, and had to sustain a pressure of two atmospheres, besides being exposed to a high temperature, they received on both sides an additional coating of oil-varnish. It is, however, necessary to let such a barrel stand in the open air at least a fortnight for drying, and as a precaution fire must be kept away from the barrel while being prepared. As a further precaution, in applying the solution inside, the workman must not be left alone, as it frequently happens that stupefying vapors from the solvent of the paraffine arise, which stupefaction, however, soon disappears in the open air. The oil varnish may also be diluted with petroleum ether, poured into the barrel, and then the latter rolled about, as above described; but many places escape saturation in this operation. After coating with varnish, the barrel is once more dried, and then filled with water, in order to force out the combustible gases. This is much to be advised, as an explosion once took place in consequence of a workman trying to enlarge a hole with a red-hot iron, contrary to orders. After the last operation, the inner sides of the various vessels are rubbed down with a dry duster, so as to take off all loose particles.

If the impregnation of wood is intended on a large scale, the wood is best stacked in iron boxes, the paraffine solution poured over it, the solution not absorbed drawn off after some time, the solvent forced out of the wood by means of warm air, and recovered by condensation in a cooling apparatus.

If the various manipulations are carefully carried out, the duration of vessels thus prepared is increased from four to six fold, while the outlay is comparatively small, leaving out of consideration that the contents of such vessels are frequently lost by the bottom being forced out.

Paraffine, melted with equal parts of linseed oil or rapeseed oil, is also useful for coating iron vessels, which, without a substantial preservative, are very liable to rust in manufactories of chemicals.

Paraffine likewise protects skin efficiently against wet, alkalis (especially lime), acids, etc.

Dr. Schal says he often found that workmen in alizarine factories suffered much from sore, ulcerating and swollen hands, especially during winter. After the workmen began to use (twice daily) a solution of paraffine with rapeseed oil and petroleum, chapped hands (not to mention swollen or ulcerated hands) became a scarcity.

The solution is produced by melting three parts each of paraffine and rapeseed oil, removing it from the fire, and adding eight parts of petroleum while stirring the mixture. Before using, the solution is stirred a little, and the hands rubbed with it while they are clean and dry. In larger factories, earthenware and tin vessels, filled with this ointment, are placed at convenient spots, and it is believed that the manufacturer as well as the workman will find this pay.

SWANSEA WATER-WORKS RESERVOIR.

One of the excursions made by the members of the British Association during the recent meeting of that body in South Wales was to the Swansea water-works, where Mr. Edward Cousins, M. Inst. C. E., read a paper embodying some notes on the construction and repairs of the Lliw reservoir, Swansea. He said:

The Act of Parliament giving powers to the Swansea Town Council, as the Urban Sanitary Authority, to construct reservoirs on the Llan Lliw and Blaenant Ddu streams, and for laying conduit and mains for conveying water to Swansea, was obtained in 1860. The Town Council thereupon determined to proceed, in the first instance, with the construction of the Lliw reservoir only, and contracts were entered into, and the works commenced in the month of March, 1862. The reservoirs are constructed in valleys of denudation in the coal measures, the strata consisting of alternating beds of rock and shale. The workable seams of coal beneath the reservoir site being at a depth of about 500 ft., the surface of the valley being covered with alluvium, but only to a moderate depth. Through the whole length of these valleys there are springs of water, some permanent, but others which only flow after long-continued rain, the surface-water entering fissures in the exposed joints of rock, and finding an outlet at lower points. The Lliw embankment has a base line in the direction of the valley of 425 feet, with a puddle trench in or about the center, carried at the deepest part 99 feet, the lower portion being in rock. In this rock there were thin open joints and small springs of water, and on the outer half of the embankment seat other small springs exist, all of which were drained to a common outlet into a permanent drain cut in the rocks and covered with lime concrete. The bottom of the trench was also directed to be formed with concrete, so as to prevent injurious action of the small springs on the bottom of the central puddle wall. The drain from the outer part of the embankment delivered a steady flow of clean water, increased after heavy rain, but unaffected by any head of water in the reservoir. The volume of water varied from 27,360 gallons per day to 54,720 gallons, after much rain. This water went to provide compensation. The contingency of springs of water in puddle trenches and beneath the outer portions of embankments is common to most reservoir embankments of considerable size, and these are usually provided for in some such way by drains as here indicated. There are, of course, springs of water within the puddle wall, that is, over the area covered by the inner half of the embankment, as also that area covered by the impounded water. The Lliw embankment was completed and the reservoir filled to overflowing in October, 1867, impounding about 300,000,000 gallons of water, the depth from the full water-line to the surface of the ground being 66 feet, and to the bottom of the puddle-trench 94 feet. The reservoir continued in work, and apparently water-tight up to February, 1873. In the spring of 1873, violent and heavy storms of rain occurred, and apparently water found its way by seams and fissures to the bottom of the puddle-trench, and ultimately to set up a small flow of water from the reservoir through the leak thus formed. That some action must have caused such leak was shown by the outflow of water from the embankment drain becoming turbid. When, by examination and continued observation, it was made evident that a leak had been sprung, the head of water within the reservoir was reduced, the action of the drain carefully watched, and the results duly recorded. It was noted that the action was intermittent: that is, the leak varied in turbidity from time to time, and the volume escaping increased as the head of water in the reservoir increased. About January, 1874, it was noted that visible subsidence in the embankment had commenced, when extra care was taken to reduce the head of water in the reservoir, and to watch the flow from the drain. It became evident that the leak was not likely to stop, and as water was necessary for Swansea, the Blaenant Ddu reservoir was commenced, and when completed, tested, and found to be sound; means were then at once ordered to be adopted to restore the Lliw to its original state. This work was commenced in June, 1879, and was completed about the end of October last. The method adopted in repairing the embankment was as follows: An open cutting was made transversely through the embankment 160 ft. wide at the top, and 50 ft. wide at the bottom, to a depth of 36 ft. below the top of the embankment. A trench 30 ft. long and 20 ft. wide was then sunk from the bottom of this cutting through the puddle wall to the rock, a depth of 70 ft., or a total depth of 106 ft. from the top of the embankment. In sinking this trench, indications were soon observed that the puddle wall was fractured. The fractures as at first discovered were small and branching, and were filled with sand formed by the washing of the selected material from the inside slope of the embankment. At a depth of 24 ft. in the trench, the puddle wall was found completely punched through, and this fissure (which was about 2 ft. wide) was filled up with the coarser parts of the selected material of the embankment. This fissure extended down to the face of the rock where a spring was discovered that had evidently, during the extraordinary rainfall in 1873, burst through the layer of concrete on the rock at the bottom of the puddle trench. The spring must then have acted directly upon the base of the clay puddle-wall until it formed a passage across the bottom of the puddle-trench, thus allowing the water in the reservoir to find its way through the puddle-wall into the drains underneath the outer slope of the embankment, the outlet of which is at the base of the bank. This continual wearing and washing-away process of the clay-puddle caused it to settle down from time to time, resulting in the puddle becoming fractured, and the pressure of the water in the reservoir caused the material from the inside slope of the embankment to wash into and fill up these fractures in the clay wall. Having proved that the defect was confined well within the extent of the trench, it afterwards became necessary before commencing to refill the trench to make provision for relieving the pressure of water arising from the spring, and for this purpose the rock at the bottom of the trench was excavated to sufficient depth, and the drains were constructed over the several fissures conveying the water to one point, from which an iron pipe was laid, passing up the shaft to a height of 17 feet, and passing thence through a heading to the drains underneath the outer slope of the embankment. The brick drains and the whole area of the bottom of the shafts were then covered with a layer of Portland cement and afterward with Portland cement concrete, which was carried up to the level of the old concrete. After this was completed, the drains and pipes were tested, when it was found that the spring water rose to a height of 17 ft. through the iron pipes, and then discharged itself into the old drains underneath the embankment without the slightest indication of any escape of water at the bottom of the shaft. The trench was then filled with fresh pugged clay puddle, and well rammed by means of hand rammers and a monkey, weighing 1¼ cwt., with a fall of about 6 ft. The new clay was put into the shaft with a very little admixture of water, in order to obviate as much as possible any subsequent settlement, and the new clay was well jagged in the face of the old clay at both ends of

the trench. In sinking the trench it had to be timbered in a substantial manner, and in such a way that the timbers in refilling could be withdrawn in small sections, so as to prevent any settlement or movement in the remainder of the embankment, as had any settlement taken place in the old clay puddle during the progress of the work, as would have proved fatal to the success of the scheme. In carrying out these repairs, no indication of any settlement has shown itself at either end of the trench, and I have great confidence that the works will prove a success, and that the embankment will be made sound and water tight. The embankment of the reservoir is 80 ft. in height, having a water area of 32 acres, and containing, when full, 300,000,000 gallons. Mr. Robert Rawlinson, civil engineer, was engineer to the Corporation of Swansea during the first period of the works, as for the original surveys, the obtaining of the Act, and the partial completion of the embankment, Mr. Hugh Unsworth being resident engineer up to the completion of the Lliw Embankment. Mr. Rawlinson re-entered government service before the embankment was fully completed, but by special leave of the then Home Secretary continued to act as consulting engineer to the completion of the works. For the repairs and restoration of the Lliw reservoir I have been the acting engineer, and Mr. Rawlinson, with the sanction of the president of the local government board, the consulting engineer, as it was considered desirable by the water company of Swansea that the engineer who designed and executed the works which had given way should be responsible for their restoration.

NOTES.

BELGIAN PRIZE ESSAY.

It appears to be a fact not generally known in the United States that a prize is annually offered by His Majesty, the King of the Belgians, amounting to the sum of 25,000 francs, for the encouragement of intellectual effort.

The intentions of the King were made known by a decree dated the 14th of December, 1874, inviting the authors of all nations to compete, and placing the settlement of the award in the hands of a jury appointed by His Majesty, composed of seven members, three of whom must be Belgians, and four foreigners of different nationalities.

The prize for the year 1881 will be awarded "to the best work on the means of improving ports established on low and sandy coasts like those of Belgium."

The original time for sending in these essays, which may be either printed or in manuscript, was the 1st of January, now last past, but we are authorized in stating that the time has been extended to the 31st day of March, 1881.

Foreigners desiring to compete for this prize are required to send their works to the Minister of the Interior at Brussels; but Mr. John Eaton, U. S. Commissioner of Education, advises competitors in the United States to forward their articles through the Department of State at Washington.

We are informed that the manuscript work obtaining the prize must be published in the course of the year following that in which the prize shall have been awarded, but in what manner the publication shall be made is not stated in the document placed in our hands.

Engineers and scientific men who would avail themselves of this opportunity must act promptly, and we would advise such to apply directly to Mr. John Eaton, of the Bureau of Education, in regard to any further information required for facilitating their work.—*Science.*

PHOTOMETRICAL STANDARDS.

Several attempts are now being made to construct a standard photometer, or rather a standard sensitometer, as it is rather barbarously termed, since the attempts referred to are being made by photographers and are for the purpose of measuring the actinism of any light, rather than the actual amount of the light itself. One of these is by Mr. Warnerke, and a brief description of it is given in a recent number of the *British Journal of Photography*. Mr. Warnerke proposes to employ different varieties of luminous paint for the purpose. It has been ascertained that the different metallic sulphides employed for this purpose are sensitive in the different degrees to the different parts of the spectrum, and it is further said that a similar difference is found in different specimens of the same sulphide. The *Journal of Photography* states that from the most generally used sulphide, calcium sulphide, "it is possible to prepare different materials so as to give off a phosphorescent light, varying very greatly in color, from violet and blue to red." It is not stated precisely how Mr. Warnerke applies these principles; but supposing it to be possible to produce a material of standard sensitiveness, it is not difficult to imagine that it might be possible to construct both a standard unit of light—that is to say, a surface of given area covered with a material which might be equally sensitive to all sorts of light, and would show merely the amount—and also to construct a sensitometer, which would show the amount of blue and red rays in any given light, and consequently the actinism of the light. M. Léon Vidal has also recently brought a selenium photometer before the Paris Photographical Society. From the description given it does not really differ from the "selenium eye" of Dr. Siemens. The *British Journal of Photography* gives a description of a selenium cell mounted on the top of a photographic studio and arranged so as to show on a galvanometer within the amount of light falling on the selenium at any moment, so as to enable a photographer to judge the amount of exposure necessary for his plate. It is hardly possible to doubt that this arrangement is, at present, purely imaginary, as is also the suggestion that an automatic arrangement should be attached to the camera which should expose the photographic plate a varying length of time, according to the amount of actinism in the light. M. Vidal states that he has not found his selenium subject to the "fatigue" which has been so commonly noted by all who have had the slightest experience of the action of selenium previously. He further states that whatever be the color of the light thrown on the selenium it appears to make no difference. Here, again, he is entirely at variance with the authorities in this country.—*London Times.*

A CURE FOR SMOKE IN FIRE-PLACES.

The growing obscurity which distinguishes the winter atmosphere of London has been traced to the partial consumption of coal under the present system of domestic fires. Whether these "fogs" are unavoidably connected with the use of coal in great centers of population is a question now attracting general attention in London. In an article in *Nature*, Dr. C. William Siemens says he is "decidedly of opinion that the evil is one which not only admits of remedy, but that its cure would result from a closer attention to the principles of economy in the use of fuel." The ordinary gas-grates are objectionable on account of the expense incurred and the smell and dry heat which attend their use. "The first condition to be realized in an efficient gas grate," Dr. Siemens says, "consists in suppressing all gas orifices except immediately behind the bottom front bar, and in substituting for the grate a solid dead plate, instead of using inert matter, such as pumice-stone. I consider it far more economical and efficacious to transfer the heat of gas flames to gas coke or anthracite, which, when once heated, helps the gas to increase and maintain a sufficient temperature for radiation through its own slow combustion. The gas should not be mixed with atmospheric air to produce a Bunsen flame, because by using unmixed gas a rich flame is set up between the pieces of coke near the front of the grate, and the hot carbonaceous matter through which it percolates insures its entire combustion before reaching the chimney."

Dr. Siemens has constructed a gas-grate which may be described as follows: At the bottom of the grate, on a line with the top of the bottom front bar, there is an iron dead plate riveted to a stout copper plate facing the back of the fire-grate. The dead plate stops short about an inch behind the bottom bar of the grate to make room for a half-inch gas-pipe, which is perforated with holes, about one-twentieth of an inch in diameter, placed zig-zag at distances of three-quarters of an inch along its upper surface. The copper plate extends five inches above and below the dead plate. The gas-pipe rests upon a plate on a line with the bottom of the lower front bar, and about one inch below the dead plate. This plate is bent so as to leave a vertical and horizontal channel of about one inch in breadth between it and the dead plate. A trap door under the gas pipe permits the discharge of ashes falling into this channel. The vertical portion of the channel is provided with a sheet of copper, about four inches deep, bent in and out like a lady's frill, and riveted to the copper back piece. The back piece transfers the heat from the back of the grate to the "frill," and the air current created by this heat, in passing along the horizontal channel, impinges on the line of gas flames and greatly increases their brillancy. So great is the heat produced by this simple arrangement that a piece of lead weighing one-half of a pound which was introduced through the trap door was melted in five minutes, proving the existence of a temperature exceeding 619°. The abstraction of the heat from the back of the grate (while not essential) has the advantage of retarding the combustion of the coke there, while promoting it at the front. In nine hours this grate consumes sixty-two cubic feet of gas and twenty-two pounds of coke. At London prices —about 85 cents per thousand for gas and $4.35 per ton for coke—the cost of the fuel for nine hours is less than 10 cents. As a coal grate the fire-place generally consumed forty-seven pounds of coal a day, at a cost of nearly 12 cents. Besides being cheaper, the coke fire has the advantage of being warmer than the coal fire, smokeless and easily lighted and extinguished.

Dr. Siemens thinks the time will come when all fuel will be separated into its two constituents before reaching the domestic hearths, and that such a measure would furnish a complete solution of the smoke question and be of great value in the saving of money.

COTTON-SEED OIL.

The cotton-seed oil manufacture is now the leading industry at New Orleans, its six mills employing 1,525 persons and producing $2,742,000 worth of oil annually. There are nine mills in both Mississippi and Louisiana, eight in both Tennessee and Texas, four in Arkansas, two each in Missouri and Alabama and one in Georgia. They all can crush 1,786 tons of seed daily. The 47 mills in the whole country only crush an eighth of the seed available for oil, their annual oil product being valued at about $6,000,000.

GLASS MAKING IN OHIO.

Five new glass works were started in Ohio last year, and several more will be added this year. The latest official statistics give nineteen firms employed in glass manufacture, with thirty-two furnaces, having 292 pots and employing 2,032 men. In the production of window glass there are employed seven furnaces, with sixty-six pots; flint glass, nineteen furnaces with 199 pots; green glass, four furnaces with twenty-seven pots. The glass works are in Bellaire, Columbus, Ravenna, Kent, Zanesville, Steubenville, Martin's Ferry, Bridgeport, La Grange and Newark.

THE EFFECT OF LIGHT ON TREE GROWTH.

From observations made during nearly twenty years in a forest in the Jura, it appears to be proved —first, that when light strikes the ground without having been sifted by foliage, it stimulates the production of carbonic acid in the soil; secondly, that the growth of wood is diminished when the underbrush is so thick and tall as to impede the passage of sunlight to the soil and its reflex action on the branches of the trees; and, thirdly, that mould in too great a thickness becomes inert, and thus remains for many years, as is the case with barnyard manure when too deeply buried.

FLASHING SIGNALS.

Intermittent luminous signals are likely to be useful for enabling lighthouses to flash their distinctive names by the Morse code according to the idea of Sir William Thomson, or for preventing collisions between two ships at sea, and it is therefore important to secure a good means of producing them. When a steady light is occulted by a movable screen, as in Sir William Thomson's latest plan, there is a waste of the light during all the periods of eclipse; and hence it would be more economical to find a way of raising the light to produce the signal flash, and lowering it again to produce the dark spaces. The new petroleum-oxygen lamp of M. Dubosq, the Parisian optician, is so constructed as to answer the purpose very well. The wick is round, and a supply of oxygen gas is directed by a pipe from the gas reservoir into the center of the flame. When the oil is burning in the ordinary air, the flame is of the ordinary brightness; but when the jet of oxygen plays upon it, the brilliance rises almost to that of the oxyhydrogen light. By letting on or stopping the supply of gas, then, a series of vivid flashes can be generated, and luminous signals produced. The required regulations can be readily effected by operating a Morse key arranged to constrict the India rubber pipe carrying the supply of oxygen from the reservoir to the flame.

DUST AND FOG.

A remarkable paper, communicated by Mr. John Aitken to the Royal Society of Edinburgh, on Dec. 20, throws quite a new light on the origin of fogs, mists and clouds. Mr. Aitken has made a great number of experiments with moist air at various temperatures to determine the conditions which produce condensation of water vapor, and his conclusions, briefly stated, are, that whenever water vapor condenses in the atmosphere, it al-

ways does so on some solid nucleus, that dust particles in the air from the nuclei on which the vapor condenses; that if there were no dust, there would be no fogs, no clouds, no mists, and probably no rain; and that the super-saturated air would convert every object on the surface of the earth into a condenser, on which it would deposit as dew; lastly, that our breath, when it becomes visible on a frosty morning, and every puff of steam, as it escapes into the air from the engine, show the impure and dirty state of the atmosphere. These results have been verified at temperatures as low as 14 deg. Fahr., at which, however, there was little cloudiness produced, owing to the small amount of vapor in air so cold. The sources of this dust are many and various; for instance, finely ground stone from the surface of the earth, the ash of exploded meteorites and living germs. Mr. Aitken showed experimentally that by simply heating any surface, such as a piece of glass, iron or wood, a fume of solid particles was given off, which, when carried along with pure air into a receiver, gave rise to a dense fog mixed with steam.

So delicate is this test, that the hundredth of a grain of iron wire will, when heated, produce a distinct haziness in the receiver. By far the most active source of these fog-producing particles is, however, the smoke and sulphur given off by our coal fires, and as iron gas grates will not prevent the omission of these particles, Mr. Aitken thinks it is hopeless to expect that London and other large cities of the country can ever be free from fogs. However, inasmuch as more perfect combustion will prevent the discharge of soot-flakes, our fogs may be rendered whiter, purer, and therefore more wholesome, by the use of gas grates, such as those recommended by Dr. Siemens. Mr. Aitken also drew attention to the deodorizing and antiseptic powers of smoke and sulphur, which probably operated beneficially in killing the deadly germs, and disinfecting the foul smells, which cling about the stagnant air of fogs, and suggested caution lest, by suppressing smoke, we substitute a greater evil for a lesser one.

THE TERNIKOFF ARTIFICIAL STONE.

The Ternikoff process, recently invented, for producing artificial stone, is described in the foreign journals as successfully meeting some of the difficulties hitherto presented in this industry. According to the method in question a mortar consisting of equal parts of lime and sand is exposed for a few hours to a temperature of 150° Centigrade, in the presence of water vapor. The paste, having been taken out of the furnace, is passed under the cylinders of a machine like that used for the molding of bricks, and it comes out in the form of cubes which, on being exposed to the air, become dry and hard; in the course of some eight or nine hours the cubes acquire a hardness equal to that of good building stone, and are fit for use. This new stone is, in fact, a sort of brick of mortar baked at a low temperature, and the cost, too, is about the same as that of bricks.

A CABLE-LAYING SHIP.

A cable-laying ship possibly represents the highest development of marine engineering, for a hitch in the machinery may mean the failure of the expedition. An instance of the perfection which has been reached is furnished by the cable ship Kangaroo, which ran recently from New Zealand to St. Vincent without once stopping the engines. The distance of 9,500 miles, supposing about 16 miles to be run every hour, represents continuous work for 25 days—a fairly sufficient testimonial to the excellence of the machinery.

GENERAL INTELLIGENCE.

☞ *We solicit and are always pleased to publish in these columns any items of interest that may be furnished us.*

GAS AND WATER.

The Colorado Coal and Iron Company has submitted to the Mayor and Common Council a proposition to furnish the town of Pueblo with water.

Boston wants its high-water service system extended, and it is proposed to construct a 15,000,000-gallon reservoir in Brookline, and have two new engines placed there, capable of pumping 10,000,000 gallons each daily.

The recent flood was the most severe test the Columbus, O., water-works ever had. The tunnel was completely under water about eighteen hours, and yet the water supply on the 11th was as good as if nothing unusual had happened.

William R. Plunkett, who has had a large experience in managing water-works, thinks a water company can be profitably started in Lee, Mass., to supply the village with water, and accordingly has revived the old Berkshire water-power company there.

The annual report of City Works Commissioner French Brooklyn) was made public on the 14th. The receipts for the year were $1,128,438.43. The water debt was increased $163,000, and now amounts to $11,879,500. The average daily consumption of water was 30,744,590 gallons.

FORT DODGE, Ia., Feb. 10.—So many fires here of late have led the city to offer a reward of $250 for information that will lead to the conviction of any incendiary. The Council has also adopted a system of water-works combining direct pressure for fire purposes, with a reservoir for domestic supply, and appointed a committee to advertise for bids.

The Maysville Water-works were tested and accepted on the 5th inst. The consideration for the fulfillment of contract and free use of fifty fire-plugs was $50,000. The works consist of one two million condensing and one one and a half million high pressure pumping engines, with two sets of tubular boilers 26 ft. by 46 in. diameter. The pumps are located in a 15 ft. circular well 50 ft. deep, with the engines above high water. They pump direct from the Ohio River, against a pressure of 418 ft., into two settling reservoirs of two millions gallons capacity. The pipe system consists of 40,000 ft. of pipe from 14-in. down to 4-in. pipe, the largest number being 8-in. pipe. They have an average pressure of 135 lbs., throw water 150 ft. high, or 15 streams any place over 100 ft. high simultaneously.

One of the corporators named in the bill now before the assembly to provide for supplying New York and other cities with water from Lake George, said yesterday: "The bill means what it indicates and nothing more. The experience of the present winter shows that the water supply of New York City is not what it should be. A bountiful supply of water is good from a sanitary point of view, and the inhabitants of New York City should not be restricted in its use. The work proposed will be a combination of open-cut aqueduct and piping. The minimum amount to be brought from Lake George will be 100,000,000 gallons daily, and the maximum 200,000,000 gallons. Surveys have been made by competent engineers, and the amount necessary to construct the work has been estimated. We do not think it will exceed $15,000,000. The towns and cities along the line of the proposed route will probably be supplied in whole or in part. Poughkeepsie, Albany and Troy, especially, are often short of water, and their supply is poor in the best of times. The water of Lake George is among the purest to be found anywhere, and is practically inexhaustible. It is proposed that it shall be tapped at the Fort William Henry, or upper end, as it is generally termed."—*Exchange.*

ELECTRICITY.

The Akron Iron Co. finds its new Brush electric light quite a help at the rolling mill. The completion of the additions to the mill has been delayed by the severe weather.

What Mr. Cyrus W. Field's plans are no one can ever foretell, but, judging from an interview with him which appeared in the *North China Daily Mail*, the veteran ocean cable-layer is likely to link the countries bordering the Pacific as he has done those on the Atlantic. On being interrogated as to whether he had come to lay a cable across from Yokohama to San Francisco, Mr. Field said that it was simply a matter of money, and that if that were forthcoming the cable would be also, as no less than three routes, with accurate soundings, had already been marked. Further than this the oracle would not say, but it appears that he did not actually deny the truth of his supposed object in going to China, so that the next move on the telegraphic chess-board may be a Pacific Cable Company.

STREETS, DRAINAGE, ETC.

The chief engineer of Buffalo has returned from New York, where he had gone to submit plans for a new sewer from Hamburg street to the canal. The canal and harbor will be tunnelled in carrying out this work, and the sewerage discharged into the swift current of the river. The specification provides for an arch sewer, 12 feet by 10, along the Hamburg Canal, and then circular in form, with an average diameter of 11 feet. Three hundred copies of the specifications are to be printed.

BRIDGES.

The canal bridge at Port Clinton, Pa., was carried away during the recent flood.

The contract for building the Missouri, Kansas & Texas bridge has already been let, and boring for a foundation has already been made.

A portion of the Rock Island Railroad bridge was swept away by ice. The Illinois has risen twelve feet and gorged at the mouth of the Vermilion.

The Macon & Augusta Railroad, bridge over the Ocmulgee river, at Macon, Ga., was washed away last Wednesday, the second time within thirty days.

The railroad bridge at Monroe, Mich., was carried away by the freshet. The lower part of the city is inundated. The damage to that part of the city is $100,000. Much damage to property is reported in the adjoining country.

A dispatch from Marion, Ind., Wednesday, says: The Cincinnati, Wabash & Michigan Railway bridge over the Mississinwa River, one mile north of here, was entirely swept away by ice, which had gorged during the night, just above the bridge. Passengers have been transferred across the creek all day. Great fears are entertained of several other bridges on that road. This evening all trains were abandoned. The streams are so high that the management concluded to hold all the trains in safety. The President, J. H. Wade, will arrive in the morning to arrange for new bridges. The damage amounts to several thousand dollars. C. F. Mather, the agent of the road, fell from the bridge just before it was swept away, and was fatally injured by striking upon his head and shoulders on the ice beneath.

The water has risen slightly at Georgetown and Harper's Ferry. The flood in the Potomac River, which submerged the lower portion, has subsided. The immense ice gorge, extending from above Washington to a point several miles below, and reaching nearly over to the Virginia shore, accumulated, and now lies immovable, threatening destruction to the wharves and a number of the steamboats when it moves. The damage already to vessels at the wharves, and property along the river front is from $50,000 to $100,000. The damage to property in that portion of the city which was inundated will probably reach $100,000. In Georgetown, along the wharves and in storehouses, the damage will probably amount to $75,000. The section of the long bridge, swept away Saturday night, was carried down the river, and lies on the flats badly wrecked. Telegraphic communication with the South is badly interfered with, as all the telegraphic cables at the long bridge have been carried away.

RAILROADS.

There will likely be a Railroad Commission in New York and one in Illinois.

The plan of a railroad between Newport and Island Pond is again under discussion.

The International and Great Northern Railway has been completed to San Antonio, Texas.

The Chesapeake & Ohio Railway claim that their Chicago connection will be completed within 30 days.

Many engineers have arrived, and a large quantity of material has been landed for the American companies in Mexico.

There is growing probability of a consolidation between the Peoria, Decatur & Evansville and the Ohio Central roads.

The Delaware & Hudson Canal Company will lay steel rails on the Rutland & Whitehall (N. Y.) Railroad the coming spring.

The Detroit & Bay City Railroad was sold on Saturday (12th) on a foreclosure sale to James McMillen and Henry B. Ledyard for $3,625,075.

OTTAWA, Feb. 14.—Mr. Sandford Fleming is collecting Pacific Railway reports, correspondence, etc., with a view to publishing them in pamphlet form.

Among the orders for additional material for the Northern Pacific road, a Pittsburgh firm is to supply 22,000 kegs of railway spikes this year.

The Chesapeake & Ohio Railroad has recently given an order for forty-two new engines, some of which are to be about double the capacity of any now on the road.

The Delaware & Hudson rail tracks are to be doubled between Schenectady and Binghamton. It is also stated that surveyors from Albany are at work for a double track.

Work has been commenced on the first six miles of the Lexington branch of the Richmond and Alleghany Railroad. The contract will be let to Lexington on the 1st of March.

Work has been suspended on the first hundred miles of the Canadian Pacific Railroad west, and most of the men have returned to the city. It is believed the suspension is temporary. The greater portion of the men expect to be re-engaged under the syndicate.

The bill authorising the consolidation of the St. Paul & Sioux City Railway with the Chicago, St. Paul & Omaha, formerly the Chicago, St. Paul & Minnesota, and North Wisconsin Railway, has passed both houses of the Legislature of Minnesota, and will be signed by the Governor.

The completion of the Brooklyn Elevated road may be regarded as probable, if it be true that the capitalist who encouraged the building of the Third Avenue, or New York Elevated, has taken a pecuniary interest in the Brooklyn (Bruff) Elevated, as is now inferred from the list of the committee.

Summer travel has assumed such proportions that the Pennsylvania Company is building a new road to the sea shore called the Philadelphia & Long Branch Railroad, running from Whitneys, due east to Barnegat Bay, crossing it on a bridge 7,000 feet long, to Sea Side Park, thence north along the beach to Manasquan Islet, 12 miles below Long Branch, being 55 miles from Philadelphia.

General McClellan has been elected President of the Broadway (New York) Underground Railroad Company, and is going to Europe to place the bonds on a foreign market. The route to be pursued is not known; nor under what charter the company proposes to act, as, though six charters were obtained from the legislature, they were all supposed to have been vetoed or lapsed by failure to commence work.—*Exchange.*

DAYTON, O., Feb. 11.—The Baltimore and Ohio Railroad, having obtained virtual control of the Dayton & Southwestern Narrow-gauge road, a scheme was devised to save it to the original stockholders. It has $1,000,000 stock, only six-tenths of which has been issued. Last night General Corse, of the Toledo, Delphos & Burlington Road, took the remaining $400,000 and secured the road to his narrow-gauge system, which now comprises fifteen hundred miles. The road will be

fully equipped and extended to the Ohio River. It already extends southeast from Dayton one hundred and twenty-five miles.

The Mexican railways which American capital is building are fairly under way. The Mexican Central Company has laid about thirty miles of track from the City of Mexico north, and the graders are at work for about fifteen miles beyond. On the Sonora Railway, from Guaymas, about thirty miles are completed, and the rails are going down at the rate of half-a-mile a day. The Mexican National Railway Company (Gen. Palmer's enterprise) has ordered forward a large force of engineers to Manzanillo, on the Pacific coast, for work on the section of the road between that place and Colima, and a large amount of material and supplies, including 4,000 tons of steel rails. Work is also progressing from Laredo south.

San Antonio (Tex.) *Express*, Feb. 9: The International tracks at this place, embracing main and side, are getting to be very expensive.——Work on the International freight and passenger depots was commenced yesterday.——It is said that the raising and framing gangs at the International lack the lumber with which to proceed further.——The Sunset is represented to be paying grading contractors three cents more per cubic yard than the International is, ane hence is taking quite a large per cent. of the forces away from the latter road. —The Sunset is pushing on rapidly, and with a spirit that indicates that the company does not allow itself to be outdone if it can help it.—— Maj. Converse returned last evening from a trip along the Sunset extension, and reports the work to have reached a point about 24 miles from this city, and below Castroville. Everything is moving on smoothly.——A gentleman just returned from Fort Clark says that a few days ago a party of men representing themselves to be railway employés came to the town of Brackett and purchased supplies. They conveyed their freight to a point on the Rio Grande below the mouth of the Pecos, whence they shifted it to boats and proceeded thence up the stream to a point above the mouth of the Pecos. They were evidently a part of Captain Hood's Southern Pacific engineering party. It is thought this road may connect with the Galveston, Harrisburg & San Antonio Railroad at Fort Clark, and run an independent line thence down the Rio Grande.

The following is an exhibit of the new railroad construction in Texas during the year 1880: Corpus Christi, San Diego & Rio Grande—This road, at the begining of the year, extended from Corpus Christi, Texas, due west 53¼ miles to San Diego. In 1880 an extension toward Laredo was begun, on which track was laid for 5 miles southwest, and most of the grading completed about 50 miles further to Alberca, whence the line is to extend west by north to Laredo. Gauge, 3 feet. Dallas & Wichita—Extended from the former terminus at Lewisville, Texas, northwestward 17 miles to Denton, making the road 39 miles long from Dallas northwest. It will be worked as a branch of the Texas and Pacific. East Line & Red River—Extended from Sulphur Springs, Texas, westward 30 miles to Greenville, making the line 123 miles long from Jefferson west by north. Guage, 3 feet. East Texas—On this road the first track was laid, from the Texas and New Orleans, at Beaumont, north 6 miles to Pine Island Bayou. Galveston, Harrisburg & San Antonio—The LaGrange Branch was built from the main line at Smith's Junction (three miles east of Columbus), west by north 16 miles to Ellinger. Gulf, Colorado & Santa Fe—Extended from Sealy, Texas, northwest 110 miles to Rogers, making the road 204 miles long from Galveston northwest; Houston & Texas Central—The Texas Central road, which is an extension of this company's Waco & Northwestern Division, was extended from Whitney, Tex., westward 67 miles to Mt. Airy, Erath County, making the division 142 miles long from its junction with the main line at Bremond, which is 143 miles north of Houston. Houston, East & West Texas—Extended from Trinity River, Texas, northeastward 12 miles to Livingston, Polk County. Gauge, 3 feet. International & Great Northern—Extended from the former terminus at Austin, Tex., southwestward 62 miles to Davenport, making this line of the company 323 miles long from its junction with the Texas & Pacific at Longview, southwest, and bringing it within 18.3 miles of San Antonio, which it will probably reach this month. Missouri, Kansas & Texas—The Denison Division (late Denison & Southwestern) was extended from Whitewright, Texas, southwestward 32 miles to Greenville, the county seat of Hunt County, making the division 52 miles long from its junction with the main line at Denison. Texas & Pacific—Extended from the former terminus at Fort Worth, Texas, westward 151 miles, making the main line 404 miles long from Texarkana. The Transcontinental Division was extended from Sherman westward 17 miles to a junction with the Missouri, Kansas & Texas at Whitesboro, Texas & St. Louis—This company, at the end of 1879, had two sections of road, one of 30 miles from Texarkana southwest, and one of 21 miles from Big Sandy to Tyler. In 1880 it filled the gap of 76 miles from Sulphur Fork southwest to Big Sandy, and extended the line from Tyler southwest 52 miles to the Trinity River. Gauge, 3 feet.

RIVERS AND HARBORS.

WASHINGTON, Feb. 14.—A memorial of the citizens of Richmond, Va., in favor of a survey of the James River, with a view of securing a channel to Richmond, twenty-five feet in depth at full tide, has been presented in Congress.

TRENTON, Feb. 14.—For the past twenty-five years the people of Trenton, on one side of the Delaware, and those of Morrisville, Pa., directly opposite on the other, have been making the most strenuous efforts to dam the river at this point and thus utilize one of the best water powers in America. The project was before the New Jersey Legislature year after year, but met the bitter hostility of the shad-fishing interest from Warren to Cape May, and though the bill frequently passed the Assembly was as invariably defeated in the Senate until the session of 1876, when it became a law so far as the New Jersey Legislature could make it. Requiring the concurrence of the Pennsylvania Legislature, it was brought before that body in 1877, but no action was taken upon it. The people of Bucks County are now moving in the matter with a determination to secure a favorable consideration of the measure from the present legislature, and have appointed a large committee to visit Harrisburg, which will be reinforced by a delegation from Trenton. The concurrent bill, as passed by the the New Jersey Legislature, it is believed, will fully protect the fishing interests, as the dam and works to be constructed are first to receive the approval of the Fish Commissioners of both States.

CANALS.

According to a report on the Darien Canal, made by Joseph Nimmo, Jr., Chief of the United States Bureau of Statistics, the cost of the Suez Canal was $92,278,907. The receipts last year were $5,978,186, and the expenditures, including 5 per cent. interest upon the share capital, as a sinking fund, $5,415,542, leaving a net balance of $557,645.

The Eads fifty million subsidy bill for a ship railroad across the isthmus was overwhelmingly defeated, Saturday, in the house. Shortly after it was brought up for action, a motion to lay the whole subject on the table prevailed by so heavy a *viva voce* vote that its friends did not even call for a division. In fact there were only six negative votes. While this does not finally defeat it, in a parliamentary sense it puts it back so far upon the calendar of the House business as to render it certain that it will not pass this Congress.—*Exchange.*

We take the following from an exchange:

NEW YORK, Feb. 11.—A reporter found Capt. Eads last evening a few minutes before he took the train for Philadelphia. Capt. Eads expressed his confidence that favorable action would ultimately be taken by Congress upon his scheme of an interoceanic ship railroad. The House Committee, he said, has already reported favorably upon it, but the matter would never be brought up in the House again unless action were first taken by the Senate

"Will Congress reach any action upon it this session?"

"I think the chances are just about even."

"The Mexican Government authorizes you to pledge the proceeds of the railroad to foreign countries. Will much of the capital be raised abroad?"

"None, if the action of Congress is propitious. The United States is the only Government to which income will be pledged, and it will be very easy to raise the necessary capital on this side of the water."

"Will the amount to which the capital was originally limited be sufficient?"

"Undoubtedly."

"How will your project affect that of De Lesseps?"

"The Panama tidewater Canal will never be completed. De Lesseps, however, unless the United States should absolutely interdict it, will push work upon his canal as long as a cent of money is to be had. I do not mean to say that the canal could not be constructed across the Isthmus of Panama, but that it would never pay for the amount of capital invested. My railroad could be completed long before his canal, even if the Panama route were the only one. The canal would never pay."

"What is the outlook for the Nicaragua route?"

"That route will never be pushed. The object of those who propose it is to prevent any means whatever of conveying ships across the isthmus from being effected. They ask for a charter from Congress, and they seek no governmental assistance. This makes persons who have not investigated the subject think the route through Lake Nicaragua the least expensive and most practicable. The fact is, however, that if they wished to carry out their plan, the company would need aid from Congress. The inference is plain that the proposal is merely to withdraw support from the other enterprises. Phelps and a few others are in earnest, but they alone will never carry it through. Not a cent of capital will ever be invested in Nicaragua. Many of those who support the project are interested in the Mexican Southern Railway, which would be injured by the success of the canal or the ship railroad."

BUILDINGS.

Mr. Butler, of Warren, N. Y., has introduced a bill to legislate out of office the present capitol commission and place the Governor in charge of the structure, with power to appoint an architect at a salary of $6,000 per year.

WASHINGTON,, Feb. 15.—John McArthur, Jr., superintendent of the new Post-office building at Philadelphia, arrived there on Tuesday, in response to a telegram from Supervising Architect Hill, for a consultation regarding the completion of that building. Mr. Hill says that as soon as spring opens work will be begun on the roof of the structure, and it will be pushed forward to completion with all possible speed. Among other things, the supervising architect will obtain from Mr. McArthur his views regarding the expense necessary to put a portion of the building in immediate order for the accommodation of the post-office.

NEW PROJECTS.

A new boiler and locomotive shop is to be started at Schenectady, N. Y., which will give employment to 1,000 men.

Four enormous boilers are being built by a Point Levis foundry establishment, for the Montreal Abattoir Company's works.

A company proposes, if it can get the consent of the State of New York, to introduce the system of towing canal boats by locomotives upon rails on the banks.

It is said that the Sioux City & Pacific Railroad Company will build 120 miles of an extension the coming summer, which will advance the terminus (now at O'Neill City) to a point within 100 miles of Custer and 175 miles of Deadwood.

Mr. R. M. Frazier, general freight agent of the M. & C., who returned yesterday from Baltimore, reports that the officials of the B. & O. consider the finishing of a new road between Baltimore and Philadelphia, via the Delaware Western, a certainty of the near future.

It is said that the Pennsylvania Company is at the back of an enterprise to run a railroad from Mansfield, O., to Grand Haven, Mich., connecting thence to Milwaukee by a boat line, giving a route from Milwaukee to New York more than 100 miles shorter than any other.

Plans are being pushed for the completion of the Newport & Maysville (River Road). Almost daily meetings have been held, and the gentlemen interested have been in constant correspondence with Mr. C. P. Huntington. The agents of the company are out securing the right of way. There has been a good deal of rumor about opposition from the new owners of the Kentucky Central, but its foundation is denied.

Surveys of the Missouri, Kansas & Texas Narrow Gauge have been made through West Waco, Tex., and on two of the most important streets in South Waco, which necessarily compels the building of depots in the southwestern portion of the city. Should these surveys become permanent, it is stated by railroad men that each of the roads will build a bridge across the Brazos, about a quarter of a mile below the suspension bridge, and one block apart.

A dispatch from Angola, Ind., says: "The surveying party which has been engaged during the last two months in locating a route for the Toledo & Indiana Northern Railroad, between Fayette, O., and Goshen, Ind., has completed a very careful survey. Mr. Sargent, the chief engineer, states that a very practicable route has been found. From Lagrange west the line has not been fully decided upon. It may go to either Goshen or Bristol. In the latter case, Middlebury will be made a point."

A Kankakee (Ill.) dispatch says: "The Kankakee & Western is the title of a new railroad corporation which will send out at once a surveying party to locate a line from this city to Seneca, La Salle County, intersecting the great coal-fields which stretch continuously from Braceville to Seneca. The length of the line will be forty miles, and there is every reason to believe it will be constructed this season and will operate in connection with the Indianapolis, Cincinnati, St. Louis & Chicago road, 'Kankakee line.'"

Mr. James A. Locke, President of the St. Louis, Jerseyville & Springfield Railroad, has made the following statements in relation to the proposed roads: "Nearly the entire line is surveyed, and the route located from Springfield via Bates, Waverly and Palmyra, to Chesterfield. The company has leased 15,000 acres of valuable coal lands near Chesterfield. The coal is of superior quality, and can be mined cheaply. The entire road is ninety miles in length, and Mr. Locke thinks that it will be finished by Sept. 1, this year. The cost will be about $3,000,000.

The annual meeting of the Kingston & Pembroke Railway Company took place Feb. 8. The directors' report states that work has been commenced on the portion of the line north of the Mississippi River. It is expected traffic will be opened to the Clyde River before the end of this year. The traffic earnings for 1880 were: Passengers and mails, $12,726.80; freight, $38,277.29; total, $50,933.09. Expenditure on running account for same period, $43,488.30. C. F. Gildersleeve was elected President; Col. G. W. Flower, Vice-President; B. W. Folger, Superintendent; George Osborne, Secretary-Treasurer.

Articles of incorporation have lately been filed with the Secretary of the State of Florida for a new road to run from Tallahasse, Fla., to Pensacola and Mobile. Among the incorporators of this line are N. K. Fairbank, W. B. Strong, Vice-President of the Atchison, Topeka & Santa Fe; S. A. Kent, one of the directors of the Atchison, Topeka & Santa Fe Railroad, and Frank R. Sherwin, now President of the Maxwell Land Grant Company, a corporation owning 2,000,000 acres of coal, grazing and mining lands in New Mexico. It is the intention of the new company, which, in addition to the new line from Tallahassee to Florida, will also control the Florida Central from Jacksonville, Fla., to Lake City, and the Jacksonville, Pensacola and Mobile Road, running from Lake City to Tallahassee and Chattahoochee, as soon as the possession of the now-completed roads can be obtained, to put them in good repair and to commence and actively prosecute the work of extension through West Florida, with the ultimate view of connecting this line with the rapidly-extending railroad system of the West and Mexico, and particularly with the Atchison, Topeka & Santa Fe. This company had fully expected to make a connection with the Southern Pacific by March 1, but, owing to the unusual inclemency of the weather and other obstacles encountered, the connection cannot be completed until about the 15th. The connection will be made at Rio Mimbres, a few miles west of Florida Pass. The point is sixty miles southwest from Fort Thorn, where the Santa Fe road leaves the Rio Grande, and some sixty-five miles northwest of El Paso.